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Red Scare..... 66

In *Red Planet*, astronauts from a dying earth encounter dire obstacles as they investigate failing terraformation experiments designed to render Mars suitable for human colonization. Faced with daunting challenges of its own - including a competing project and a ballooning effects slate that threatened to top out at nearly a thousand shots - Warner Brothers called upon visual effects supervisor Jeffrey A. Okun to oversee the massive effects effort. Also recruited were a dozen effects vendors, delivering everything from space footage and zero-gravity effects to Martian landscapes and a CG robot performance. *Article by Kevin H. Martin.*

The Whos and Whys of How the Grinch Stole Christmas..... 96

For his live-action version of the beloved Dr. Seuss story, *How the Grinch Stole Christmas*, director Ron Howard created the town of Whoville and nearby Mount Crumpit on massive soundstages at Universal, then relied upon makeup maestro Rick Baker to transform actor Jim Carrey and a huge cast of supporting actors and extras into the fictional Grinch and his Who neighbors. Adding visual dazzle to the proceedings were special effects coordinator Allen Hall, in charge of on-set gags, and Digital Domain, whose virtual set extensions and other effects lent style and verisimilitude to the fantasy world. *Article by Mark Cotta Vaz.*

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COVER - A frantic attempt to avert disaster in *How the Grinch Stole Christmas*.

PUSHING THE LIMIT

ARTICLE BY
MICHAEL HEINTZELMAN



Though set in the Himalayas on K2, the world's second-highest peak, and involving the subject of mountaineering, *Vertical Limit*—directed by Martin Campbell and produced by Lloyd Phillips—distinguishes itself from previous climbing epics such as *K2* and *Cliffhanger*. Conquering the mountain is not the story's focus, and gun-wielding villains quietly sit this one out. Addressing issues of grief and the strength of family bonds, the screenplay by Robert King and Terry Hayes deals with a grown brother and sister, Peter and Annie Garrett, estranged in the three years since their father's death in a climbing accident. While Peter has become an introvert, pursuing a career as a wildlife photographer, Annie—inspired by the memory of her father—has gone on to push the limits of mountaineering. As fate would have it, their unresolved bitterness is cast aside after a disastrous accident on the slopes of K2 leaves Annie trapped in an icy tomb 26,000 feet up the mountain. Unable to accept the possibility of yet another family member dying in a climbing accident, and seeking to make amends for a decision that killed his father, Peter sets out on a potentially suicidal rescue mission.

Riding high on the success of his two most recent films—*GoldenEye* and *The Mask of Zorro*—Martin Campbell was looking for something out of the ordinary when *Vertical Limit* presented itself to him. “What attracted me was that it wasn’t a film set on the streets of Los Angeles or some other city,” recalled Campbell. “It wasn’t a film about lawyers. It was a big, outdoors picture with a fairly unique subject—mountain climbing. I knew that it would be a big challenge, physically, and that appealed to me. Also, I actually get terrible vertigo, which is probably another reason I did the film—to challenge myself. It was a kind of madness, but I thought: ‘To hell with it. Why not do something that I would never normally do?’”

Actually shooting on K2 was never a consideration due to its remote geography, brutal weather conditions and extreme elevations. “Going to the Himalayas to shoot would have been impossible,” affirmed Campbell. “Even at base camp, you’re at an elevation of 18,000 feet! We did send a very small film unit there—headed by Roger Vernon—just to get a few wide shots of K2 and the surroundings. But that was it.” After considering mountain ranges in Canada and Europe as stand-ins for the Himalayas, Campbell chose to shoot in a national park in the Southern Alps of his native New Zealand, specifically on the slopes of Mount Cook and Mount Earnslaw. Stage work would be accomplished at a studio in nearby Queenstown. “We chose New Zealand for the location shoot because it was the best look-alike for the Himalayas—albeit on a smaller scale. As far as you can see, there are mountain peaks; and the smaller scale of those peaks didn’t matter for our purposes, because they were still huge and you wouldn’t be able to tell the difference, on film and without any other reference, between a 22,000-foot mountain and a 12,000-foot mountain.” In fact, the 13,000-foot Mount Cook, set at sea level, is similar in actual height to K2—the latter’s nearly 30,000-foot elevation the result of its sitting 18,000 feet above sea level.

To prepare for the project, Campbell reviewed previous movies about climbing, such as *K2*, *Five Days One Summer* and *Cliffhanger*. “I also looked at some old silent movies from the 1920s, some of which were very impressive,” said Campbell. “All of these movies were, inevitably, stories of rescue and ‘man against the elements’—but the drama wasn’t what I was interested in. I was just looking for the way in which these movies had been shot—what looked impressive, what looked high, what created a feeling of vertigo and what didn’t. That sense of vertigo was going to be very important in this film—and yet, it isn’t an easy thing to achieve, particularly in a natural, mountain setting. If you’re shooting from the top of a high building in a city, you have tiny cars and people down below—reference points that immediately tell you how far up you are. But without those reference points, when you point the camera straight down it can look as if the bottom is only five feet away—even if there’s a great distance there.”

Capturing this feeling of height was among the most critical aspects of the movie’s visual effects agenda. Hired to deliver those effects was Anohana—a Hawaiian word that refers to finding the right tool for the job—a recently formed partnership of five visual effects veterans, including visual effects producer Tricia Ashford and visual effects supervisor Kent Houston. What brought these five together was a shared philosophy regarding the manner in which big effects movies are made—and a commitment to finding a better approach. “We wanted to change the way visual effects shows are run and produced,” asserted Kent Houston. “We’ve all been involved in shows where there has been a lot of miscommunication, a lot of disorganization, a lot of management problems. The reason that happens is because visual effects evolved from the old days of optical work—and many of those

old ideas and structures are still in place, even though they don't really apply any more. Rather than effects production redeveloping from the ground up when new technologies came along, a lot of the old practices just continued; but they don't work for these kinds of big effects shows, which need to be managed in a new and different way—very efficiently, with a few people managing the work of subcontractors. This is what I proposed to the people behind *Vertical Limit*. Anohana was a new company at the time, so the response from the studio was: 'What is Anohana? What have they done?' As individuals, we all had great track records; but on a corporate level, we hadn't done too much yet. Fortunately, we got the blessing of the studio and the production, and everyone was terrific. They understood exactly what we were trying to do, and they were very supportive of it. As a result, we were able to handle a relatively big effects show with a very small number of people."

Indeed, with Houston and Ashford spearheading the assignment, only a handful of people at two effects vendors—Digiscope and Peerless Camera—completed the majority of the film's four hundred visual effects shots. Houston's right-hand man at Digiscope was digital effects supervisor Dion Hatch. "Dion was absolutely amazing," observed Houston. "I was able to hand over a lot of tasks to him that I normally insist on dealing with myself. Grady Cofer, the lead compositor at Digiscope, was also really good. I'd done some work with him before and had a lot of respect for him—and so I insisted he be on the show. He was key in overseeing the other artists." Digital effects supervisor Paul Docherty at Peerless Camera was another integral member of the effects team, leading the creation of synthetic elements and supervising tracking and matchmoving issues. "Paul was an absolute gem. There is also an artist at Peerless named Tim Ollive who did some phenomenal matchmoving and 3D effects."

The movie opens with a harrowing sequence in which climber Royce Garrett (Stuart Wilson) scales Castle Rock in Monument Valley with his son, Peter (Chris O'Donnell), and his daughter, Annie (Robin Tunney). Above them, farther up the rock face, two maverick climbers are making a reckless ascent. A beat later, the two fall, tethered together by their safety line. As they rocket past the Garrett family—perched precariously on the sheer rock wall—their umbilical snags on Royce's pack and he is plucked off the cliffside, pulling Peter and Annie with him. Five desperate people now hang from a single rock anchor—and within moments that anchor begins to give. With the bottom two climbers having fallen to their deaths, and the anchor straining with the weight of the remaining three, Garrett implores his son to take a knife and cut him loose—an act that will mean certain death for him, but will save the lives of his children. Wracked by the terrible dilemma, Peter finally does as his father commands.

Not surprisingly, the idea of actually shooting the opening sequence in the spectacular terrain of Monument Valley was a tempting one for the film makers; but, after exploring that notion, Houston and Ashford argued against it. "They thought originally that they could do a lot of this sequence in Monument Valley," Houston recalled, "shooting at the end of the schedule. But production designer Jon Bunker, mountain rigging supremo Mike Weis and I went to Monument Valley to get our heads around how we would go about doing this; and it became very clear to us that it was not going to be possible to do it the way it had been planned—which was a combination of action shot on a small stage wall and big stunts done by stunt climbers in Monument Valley. Just getting to the locations would have been difficult, moving all those people and all that equipment in there." In addition, the fact that Monument Valley is on Navajo tribal land would have presented further restrictions, in

terms of what could be shot and where. “The logistics of shooting that sequence in Monument Valley made it impractical. So Tricia and I went to production, and said, ‘Look, we have to reconsider how this is going to be done.’”

Ashford and Houston proposed that the action be captured in three stages. A stunt crew would execute major stunts, such as falls, on a 120-foot-tall exterior wall, built on the studio backlot; first unit would shoot the actors and minor stunt work on a smaller rock face, built on stage; and a second unit consisting of stunt personnel and camera men would spend three days in Monument Valley, shooting wide views of climbers hanging from Castle Rock itself, as well as general backgrounds for the stage-shot elements. "The notion of building and shooting on a 120-foot wall had actually had been considered earlier," Houston noted, "but it had been rejected because there were structural concerns with regard to building something that tall that could stand up to the winds. But we needed that height in order to do these falls. We had a meeting with all the heads of departments and we discussed it in great detail with Martin Campbell and Lloyd Phillips—and to their credit, they said, 'Okay, this is what we have to do then.'"



Vertical Limit—a mountaineering thriller from director Martin Campbell—begins with a tragic accident that kills three climbers attempting to scale Castle Rock in Monument Valley. Though some location photography was used, falling stunts were staged on an exterior sculpted rock wall erected at a New Zealand film studio where the production was based. Effects artists at Digiscope—hired by production visual effects contractor Anohana—combined the rock wall footage with Monument Valley backgrounds.

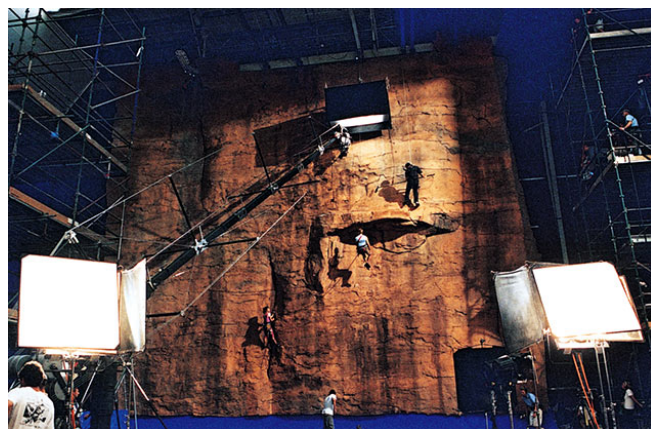
Bunker, who would be responsible for building the rock face, first modeled it in 3D in the computer, enabling the filmmakers to preplan both camera moves and stunts. Bunker then brought in a team of contractors and civil and structural engineers to build the wall out of fiberglass, plaster and timber, with aluminum wings to support bluescreen panels, then painted it an earthy red to match its counterpart in Utah. “You could see it for miles,” Houston marveled. “It was a color and texture that you really only see in places like Monument Valley—and here it was in the middle of Queenstown, New Zealand, which is very green and blue.”

Among the stunts captured on the outdoor rock wall was the long fall of the two maverick climbers after their safety rope, momentarily snagged on Royce’s pack, slips free. “One of the things we had talked about right from the beginning,” remarked Houston, “was that there were going to be falls in this film, and they had to be convincing. We didn’t want any CG figure falls, and we didn’t want any of those terrible dummy falls, with the arms and legs flopping around. We wanted natural, real-looking falls.” Campbell was also determined to avoid the cheat of high-speed photography. “Martin didn’t want to grab extra falling time by shooting at 120 frames per second. He wanted to shoot the falls in real time. So, for a four-second fall on the screen, he wanted four seconds of real falling on stage. The only way to do that was with real height—and that is what the exterior wall provided. We figured we needed at least 120 feet to get people into freefall and get enough screen time so that we could see them falling a long way—rather than do the falls in tiny, quick cuts. With this high a wall, the stunt people could actually fall a good hundred feet, and we would see that on film.”

Mike Weis and his rigging crew set up a system of winches that extended out from the rock face set, then ran cables to the top of the wall and down to a waist harness worn by the stuntmen. Thus



Members of the Garrett family hang perilously after being dislodged from the rock face by two falling climbers.



Climbing shots with actors Robin Tunney, Chris O'Donnell and Stuart Wilson were photographed on a second wall set erected on stage for maximum flexibility and safety.

secured, the stuntmen could simulate freefall for nearly the entire 120-foot drop, then slow and land safely on crashbags below with the aid of special descender rigs connected to the cables. “There was very little tension on the cables,” recalled Houston, “so they were pretty much in freefall. They could even roll and tumble on the way down.” But before even the most experienced stuntman strapped himself into the rig, stunt supervisor Simon Crane rehearsed the gag using weighted duffel bags, adjusting the descent speeds to acceptably safe levels. Crane and Weis also adjusted the rigging to ensure that the stunt men portraying the doomed climbers would not hit the rock face on their way down.

While production shot only stunt personnel on the large exterior wall, the forty-by-forty-foot interior wall built on stage provided the setting for closeups and medium shots of the actors and minor stunts. Using photographs of Monument Valley as references for texture and color, as he had for the exterior construct, Jon Bunker built the interior set out of plaster and timber on scaffolding. The rigging crews mounted attachment points for safety rigs throughout the vertical set so that actors and stunt people could be secured to it. Cameras mounted to elevated platforms and cranes captured the action, as did those set in strategic holes cut into the wall to accommodate a wider variety of angles. “Because this wall was on stage,” noted Houston, “we could completely control the actors’ environment and be extra careful in terms of safety. It was all constructed and lit so that we could do very controlled work on it.” Production surrounded the interior setup with bluescreen to enable Houston and his effects team to composite in the appropriate Monument Valley backgrounds in postproduction. “We put bluescreen around the whole thing, including the floor, upon which we laid masonite sheets painted with digital blue paint. We could pull them away and keep them to one side while people got into place and the DP adjusted the lights. Then we laid them back down when we were ready to shoot.”

The Utah filming crew recorded backgrounds and expansive views during a three-day helicopter shoot in Monument Valley after the wrapping of principal photography in New Zealand. Among the shots captured on location was a wide view of all five climbers—the Garretts and the two mavericks—hanging from the rock face. To accomplish the shot, stunt climbers dangled from a rope attached to a Castle Rock ledge five hundred feet above the valley floor.

Marrying the location aerial backgrounds with the live-action captured on the stage wall sets was problematic. “We had to bring all three of the settings—the interior wall, the exterior wall and the real Castle Rock—together color-wise, texture-wise and lighting-wise,” Houston explained. “That was difficult, partly because the color of the Monument Valley environment changes almost by the minute, depending on where the sun is and what the weather is like. Also, we’d gathered our photographic Monument Valley reference for the set walls during one season, but then went back to shoot there during another season—and that meant different colorations, as well.”



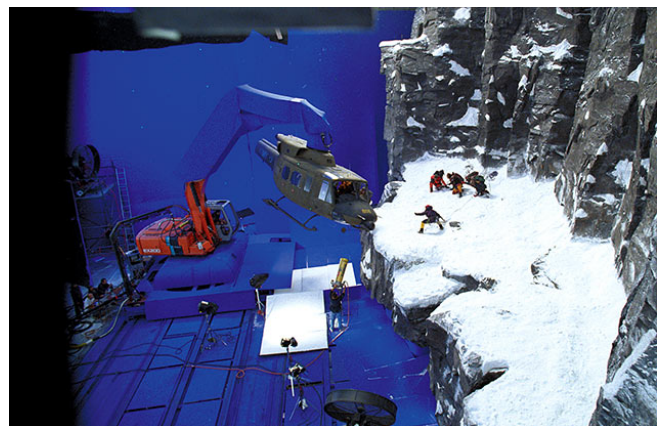
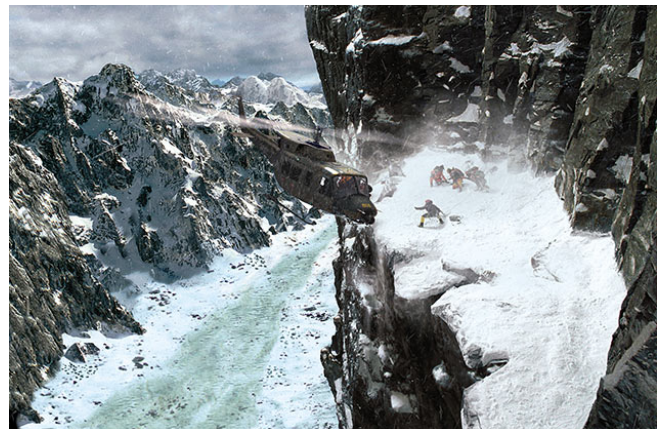
After the Monument Valley prologue, the action shifts to the Himalayas where Annie Garrett has joined a team attempting to climb K2, the world’s second-tallest peak. Although much of the action was filmed in the mountains

of New Zealand, many effects scenes employed model landscapes constructed by Cinema Production Services.

The digital compositors also had to contend with matching the colors and lighting of shots captured on the tungsten-lit interior stage wall with those filmed on the exterior wall in natural daylight. Although director of photography David Tattersall had used every available light to illuminate the interior wall, the size of the construct made it difficult to light evenly and well. The result was a restricted depth-of-field in the stage shots that was not present in either the exterior wall shots or the Monument Valley location footage. Anohana used new software tools and digital compositing tricks to tie together the on-set foreground footage and the background material. “We had to play around a lot with focus,” recalled Houston, “because if we had followed the natural focus of the bluescreen photography, all of the backgrounds would have been soft. But soft backgrounds would have minimized the effectiveness of these shots. So we cheated the background focus a lot, trying to avoid a situation in which the actor’s extremities are starting to go soft and yet the background is sharp. We did some very clever cheats in the final composites to fool the eye.”

The digital artists not only matched depth-of-field in all three settings, but also disparate colors and lighting. “Sunlight is unique in its clarity and brightness,” Houston observed, “but we did manage to match the lighting and color of the three different settings very closely on film—after shooting a lot of tests and doing a number of repaints. The red dish color was particularly difficult to work with, because we’d adjust it to get the walls to match—but then the actors would start turning orange. It took a long time to get all that footage in line. In fact, we were still working on color matching clear up to our deadline. Color and focus were the two most difficult compositing issues.”

The opening sequence ends with the image of Royce Garrett’s body hitting the ground at the base of Castle Rock. True to Campbell’s mandate that no dummies or CG figures be used in the falls, Royce’s impact was achieved by shooting a stuntman, in Monument Valley, falling seven feet from a scaffolding rig just out of the top of frame. Anohana had been prepared to do CG face replacement—substituting Stuart Wilson’s face for that of the stuntman—but the shot’s angle and brevity made it unnecessary. In fact, Houston and Ashford had gone into the *Vertical Limit* project assuming that the show would require many face replacement effects, due to its large number of stunt sequences—but that turned out not to be the case. “Both Scott Glenn and Chris O’Donnell liked doing a lot of their own climbing,” commented Houston, “so we didn’t have to do as many face replacements as we’d originally planned. Safety was very important; and they were always well rigged with wires, all of which had to be removed. But because these actors were generally



willing to get into fairly risky situations, we didn't wind up having to do much face replacement work. Also, the way Martin filmed the stunt doubles was very clever." For the final shot in the Monument Valley sequence, digital artists did augment the dust cloud kicked up by the body's impact, both to make it more dramatic and to create a visual lead-in for the next scene.

Immediately following the tragic conclusion of the Utah sequence, *Vertical Limit* jumps forward three years, joining Peter Garrett in the foothills of K2. Now a wildlife photographer for National Geographic, Peter is in the Himalayas on assignment, shooting a family of snow leopards. As coincidence, and Hollywood, would have it, Annie—from whom Peter has been estranged since the incident in Monument Valley—is also in the region, acting as documentarian for a K2 climb arranged by billionaire businessman Elliot Vaughn (Bill Paxton).

Since ninety percent of the movie was set outdoors on mountain slopes, the shooting schedule mandated frequent forays up the sides of Mount Cook or Mount Earnslaw, with cast, crew and equipment being helicoptered to spots twelve to thirteen thousand feet in elevation. "We had a brilliant grips team from Australia," noted Martin Campbell, "led by a man named Dave Nichols. They would go up to the location sites early and prepare everything for us before we got there. They flew cranes up to the mountain—all kinds of things—and they were remarkable. A helicopter would suddenly appear, drop a crane onto the mountain, and within ten minutes the camera would be mounted to it and ready to shoot. It was staggering. Our mountain rigger, Mike Weis, was brilliant at putting up these amazing rigs. He would often have to build scaffolding out from the side of a cliff—and it had to be strong enough to hold cameras or cranes or a whole crew. It would take days to build some of these rigs. They were geniuses, these people."

The logistics of shooting on mountain slopes required tremendous planning during the preproduction period. "Everything had to be worked out very carefully," stated Campbell. "It was very well organized, and much of the credit for that goes to Lloyd Phillips. We nailed down our locations early on. Once we got there, I worked out all the shots and the angles we were going to shoot with David Tattersall, the first assistant and other parties. We walked off exactly what we were going to shoot, and the order in which we were going to shoot it. I

When the climbing expedition is stranded on the mountain, Peter Garrett assembles a rescue team which is flown by helicopter to a high elevation. Unable to land, the helicopter hovers unsteadily while team members leap to a small ledge.



A stripped-down helicopter was attached to a crane-mounted gimbal on stage. Digital artists at Peerless Camera matted miniature backgrounds into the shots, restored the detached tail of the aircraft and added CG spinning rotor blades.

also rehearsed the actors every night so that once we got on the mountain, there was no discussion.”

The production required this level of precision and discipline, in part, because the shooting days on the mountain were very short. “By the time we got the equipment and crew and actors helicoptered up there,” Campbell noted, “it would be 10 o’clock in the morning; and, because of light, we had to be flown off the mountain by 4:15 p.m. So there were very few hours in which to complete shots. We really had to know what the hell we were doing to get it all done during those short days.” Some days were shorter still, due to extremely volatile, unpredictable weather patterns. “Sometimes—and this was the most frustrating part of the shoot for me—we’d go up the mountain, land, get everything unloaded and ready to go, get one shot, then have to get off again. Or we’d get everything ready up there; and before we’d shot anything at all, within thirty minutes, there’d be an urgent call and we’d have to get to the helicopters and off the mountain because the wind was coming up suddenly. It comes from nowhere. A tiny cloud can suddenly turn into a hurricane. There was a day when the weather was perfectly fine, the sky was cloudless—and within ten minutes, nobody could see a thing. We had to be led down the mountain on ropes.” Because of the inherent hardships—which included not only transportation and weather issues, but also many safety concerns that required laborious rigging of safety wires and rigs—the shoot consumed 141 days, nearly twice the number of days spent by an average production.

Though the mountain shoot went as well as could be expected, there were a number of ‘fixes’ relegated to postproduction that accounted for approximately one quarter of the total effects shot count. These digital fixes ranged from removing footprints and tracks from the snow to matching disparate skies. “The odd thing about shooting in high elevations,” Kent Houston remarked, “is that there were conditions that were real, but looked fake on film. For example, up on the mountain, we could point a camera south and the sky would be one color; but when we pointed it in another direction, the sky would be a completely different color. That’s just how it was at high altitudes. So we’d be cutting from a light blue sky to a dark blue sky—stuff that had all been shot on the same day, at the same location, but didn’t look right on film. A lot of our work involved correcting those things and getting the skies to match.” Other digital fixes involved removing safety wires and rigs from both location and soundstage footage.



Special effects supervisor Neil Corbould used giant wind machines—airlifted to the mountain locations—to simulate blizzard conditions.

Visual effects also provided enhancements for scenes, such as those which, although captured at dizzying real-life heights on Mount Cook, did not read dramatically on film. “The air was so clear up there in those alpine locations, a drop of two or three thousand feet looked like nothing,” Houston related. “It would appear as if you could just reach out and touch the bottom. So we had to employ a lot of tricks—cheating perspectives, adding particle system atmospherics and debris—just to make those drops read as a long, long way down. We had originally instructed our digital artists not to get too heavy with atmospherics because the air was so clear up there and we wanted to replicate that look. But in the end we had to add those things to make the shots read right. We also added other

environmental features—dry river beds and vegetation and things like that—to create some perspective and make the drops look more menacing.”

When a storm moves into the area where Peter is photographing a snow leopard and her cubs, he and his porter are forced back to camp. After the porter falls and breaks his ankle, the pair is picked up by a helicopter piloted by Major Kamal Rasul (Temuera Morrison) and taken to Siachen Glacier, the site of a woefully undermanned Pakistani army base and hospital. In the course of the flight, the full glory of K2, the surrounding Concordia Valley and the peaks of the Himalayas are first revealed. Standing in for much of the real topography were miniatures built by Cinema Production Services.

Helmed by Mike Joyce, the company submitted a budget to Kent Houston and Tricia Ashford early in preproduction. Once given the greenlight, Joyce and miniatures supervisor David Sharp proceeded to build the several dozen miniatures required for *Vertical Limit*. “Many of the background plates in the movie are miniatures,” Joyce commented. “We matched the area as closely as we possibly could, working from topographical maps and pictures in books. We built and photographed a model of K2 that was about eighteen feet tall and twenty-five feet wide at the base—the whole face of the mountain. We also built and shot the valley in front of it, which was about forty feet long and thirty feet wide. In one tracking shot, we start really close on the face of K2, then pull back through that whole valley.” Joyce and his crew constructed these miniatures out of rod frames, chicken wire and hardware cloth. The modelmakers sprayed foam over the basic form, then carved it into the appropriate shape. CPS also built roughly four dozen smaller forced-perspective models of the mountains leading back and away from K2. These generic models, which could be interchanged to create a variety of backgrounds, ranged in actual size from two feet tall to six feet tall.

After a strained meeting with her brother, Annie leaves with Vaughn's group, which intends to reach the summit of K2 just as the inaugural flight of the entrepreneur's new airline passes directly overhead. The huge cash outlay for this publicity stunt makes Vaughn determined to forge ahead—even against the advice of his lead guide, Tom McLaren (Nicholas Lea), who insists that the group turn back when a storm front moves in. Shots of the team trudging through the storm—a maelstrom of blasting wind and snow—required that special effects supervisor Neil Corbould simulate a blizzard on location. “We had to mock up those blizzard conditions on the mountain,” said Corbould, “because we wouldn’t have been able to climb or shoot if those conditions had existed for real.” Helicopters brought in both small and large wind machines, through which the effects crew moved real snow to create flurries. “We couldn’t use fake snow, for environmental reasons. We also filled in the flurries with smoke, which made the snowfall look a bit thicker.”

As the defeated climbing team crawls its way down the shoulder of K2, the ice crust collapses beneath Annie's feet, and she falls into a crevasse, saved only by the safety rope connecting her to Vaughn and McLaren. Corbould orchestrated the effect in an area behind the hotel where the crew was staying during the Mount Cook shoot. “We laid a sheet of glass across a hole that went about a foot deep,” explained Corbould. “Then we layered the surface of that with paper snow and polystyrene chunks. As a stunt woman walked across the glass, we detonated it, shattering it into pieces so she would drop through.”

Hanging over a pitch-black chasm as the storm rages overhead, Annie struggles to reach a ledge; but before she can, the rope supporting her snaps, and she falls into a cave of ice below. Jon Bunker computer-designed the ice cave in 3D, then built it inside a 20,000-square-foot refrigerated sound stage. Made of molded foam over steel frames, the set depicted massive, jagged ice reaching more than thirty feet to the ceiling and dropping into a trench twelve feet below the stage floor.

Anohana extended and enhanced the practical set through digital means. “In some of the shots,” Houston stated, “we modified the edge of the hole that she falls into, just to make it more to Martin’s liking. You see it from two angles—from above her as she drops through, and from below as she falls into the cave. In both cases, we did some digital work to make the edge of the hole look more interesting.” Digital matte paintings added grandeur to the cave set, extending it from a height of forty to one hundred feet.

An avalanche immediately follows Annie's fall into the cave, sending Vaughn and McLaren in after her. The film would actually feature two avalanche sequences, captured by a special film unit. “We got permission from the national parks department to set some avalanches,” explained Campbell, “so we sent a separate unit with a helicopter and its own cameras to do that.” In charge of the film crew was Canadian avalanche expert Jim Bay and American avalanche cameraman Steve Kroschel.



Rescue climber Cyril Bench loses his footing and slides down a treacherous slope, using his ice axe to catch himself at the last possible moment before plummeting off a cliff.

After choosing suitable areas for the work, the pair set explosive charges at the top of the proposed avalanche site and positioned remote cameras in its path and at its base. An orbiting helicopter would also film the ensuing avalanche, once the explosives were detonated. Beacons attached to the remote cameras allowed the crew to locate them after they were engulfed by waves of snow.

As awesome as the avalanches were in person, they lacked drama on film—primarily because the film unit had shot them in overcast conditions, as requested, to ensure that the footage would fit in with the similarly overcast main-unit work. “Unfortunately,” stated Kent Houston, “in that flat light there was no sense of scale or the magnificence of the things. So we sent the crew out again to shoot avalanches in sunlight.” The effects team remedied the resulting contradiction in lighting between the live-action and the avalanche footage by laying in digital atmospherics and snow particles to make the latter shots look less sunny.

Annie Vaughn and McLaren are trapped inside the ice cave beneath a thick layer of snow released by the avalanche. McLaren is seriously injured, and all three begin to show signs of pulmonary edema—an altitude sickness kept temporarily at bay by a meager supply of dexamethasone syringes. Back at the base camp, Peter learns of their predicament through Annie’s radio transmissions, and quickly organizes a rescue team. Five seasoned climbers agree to join him, including nurse Monique Aubertine (Izabella Scorupco), porter Kareem (Alexander Siddig), the Australian brothers, Cyril and Malcolm Bench (Steve Le Marquand and Ben Mendelsohn) and—after considerable prodding—expert guide Montgomery Wick (Scott Glenn). Peter’s plan is to deliver canisters of highly explosive nitroglycerine, courtesy of the Pakistani army, to the survivors’ last known position 26,000 feet up the mountain, then use it to blast open the mouth of the ice cave. To get a headstart on the time-sensitive rescue mission, Major Rasul helicopters Peter’s team to the highest point that can be reached by air—the Negrotto Col, situated at 21,000 feet. With the wind-battered helicopter unable to land, each member of the rescue team must make his or her way out onto the skids of the hovering aircraft and leap to a ledge below. The special effects and visual effects teams worked together to create the gripping sequence, with the former mounting a helicopter body—stripped of its rotor and tail for reasons of safety and to avoid their hitting surrounding bluescreen—to a gimbal rig, and the latter tracking digital rotor blades and helicopter tail to the stage footage and compositing in either digital or miniature backgrounds.



Fellow climber Monique Aubertine ventures onto the unstable ice in a risky attempt to save Cyril. Bluescreen stage footage was composited with miniature backgrounds by Digiscope.

When production delivered the Bell 212 'Huey' helicopter to the New Zealand studio, Neil Corbould and his team gutted it to make it as lightweight as possible. "We took everything out of it," Corbould related, "so it was just a shell. Then we put in some strengthening steel work so that we could hang it from where the rotors would have been normally. The rotor assembly was the ideal place to attach the helicopter to the gimbal system. On other shows, we've picked up helicopters from underneath; but to get a true hovering movement, we decided to pick this one up from above, at the point the rotor blades ordinarily would connect." The computer-controlled gimbal—manufactured by the special effects department—was itself attached to a modified earth excavator. "The excavator had two hydraulic arms that we could utilize, once we removed the digging unit in between them. We also added our own valves that we could control by the computer." Mounted to a 120-foot-long X-Y motion base, the gimbal system provided multi-axis movement. "We could move the helicopter up and down the stage, toward or away from the rocky set piece that was there, and we could raise it and lower it."

Next to the helicopter rig, production set up the twenty-foot-deep Negrotto Col ledge set. Both actors and stunt people jumped from the skids of the gimbal-mounted helicopter to the ledge eight feet below. "They were attached to safety wires for the jumps," Houston recalled. "Even though it was only an eight-foot drop, there were gimbal tracks and mechanisms below—falling into all of that would have been very dangerous."

In post, Peerless Camera added spinning rotor blades and restored the tail of the helicopter with 3D CG imagery, and filled in the terrain around the Negrotto Col ledge set piece. "The interesting thing about helicopter rotors," Houston noted, "is that they are either spinning so fast you don't see them at all, or they create a rather odd blurred image. In reality, you wouldn't have seen the helicopter blades at all in many of these shots—but we put them in anyway, just to make the shots look right." In addition to modeling and tracking the rotors and tail to the helicopter body, digital artists added shadows cast by same. "Fortunately, it was supposed to be a stormy scene, so it had been lit fairly flat—which helped us. It meant we didn't have to do too much in the way of shadows; though we did do some. We also had to make sure there was appropriate interaction with the environment. If the blades got close to crevices, for example, we added snow blowing off them. Another enhancement was digital heat haze coming from the turbines." The team also added in appropriate windshield reflections, since the real plexiglass sheet in the helicopter windshield had been removed to avoid its picking up unwanted reflections of cameras and bluescreen.

Peerless Camera and Cinema Production Services supplied digital and miniature Negrotto Col backgrounds, respectively. Live backgrounds were not available for the simple reason that production had never been able to find an appropriate location for the sequence. "In the end," remarked Houston, "we made a 3D digital matte painting of the environment, which included set



Martin Campbell and Chris O'Donnell discuss an upcoming climbing shot on the Monument Valley rock wall set piece constructed on stage.

extensions and a down-view onto a glacier. The backgrounds were tailor-made to Martin's specifications." Supplementing the digital backgrounds were four CPS models representing the view from Negrotto Col.

Blending the helicopter stage elements into digital and miniature backgrounds required pains taking tracking in post, especially since motion control had not been used. "Motion control would have been nice," Houston admitted, "but it wasn't practical for this movie. So we had a tracking team and a matchmoving team specifically to do that work. It was relatively trouble-free—it just took a very long time to accomplish."

Once landed on Negrotto Col, the rescue team separates into three pairs to better search the vast area for the trapped Vaughn expedition. Making his way up the slopes of K2 with his designated partner, Monique Aubertine, the irreverent Cyril Bench slips and slides toward a cliff edge and ends up hanging by his ice axe over a 5000-foot chasm. To realize the sequence—shot primarily in second unit by Simon Crane—production built a forty-foot-tall cliff and ledge set on stage in Queenstown. For Cyril's actual slide off the cliff, Crane filmed a stuntman being pulled on a cable over the ledge. "We rigged the camera on a very long crane to follow the action," Houston recalled. "Then, as he actually goes over the ledge, the camera extends out into thin air and turns back towards him hanging there. The trick there was to create the impression that the camera was moving in a three-dimensional environment—because the entire view, background and surroundings, was digital. Nothing of the view you see in that sequence is real. It's all synthetic."

As Monique attempts to loop a rope around Cyril's implanted axe and pull him back up, the fragile extension of snow and ice on which she is standing gives way—leaving the two now dangling from Monique's lone ice axe. The situation worsens when the nitro canister slips from Cyril's pack and plummets to the base of the cliff. Houston's crew created 3D matte paintings for multi-angle views of the nitro canister's fall, while the canister itself was a 3D model tumbling through virtual space. The ensuing explosion, however, was a practical effect. With the permission and supervision of the New Zealand Department of the Environment, Neil Corbould set off and filmed pyrotechnics on the crest of a real glacier. Kent Houston also filmed a fireball roaring up the face of the exterior cliff wall, with Corbould setting up the practical pyro gag. Anohana's effects artists augmented the fireball with digital smoke and particles, later combined with a moving 3D matte painting and a live-action tracking shot of Monique.

Miraculously, Cyril survives the fireball to reach solid footing, and is preparing to pull Monique up from the side of the cliff when an avalanche—triggered by the nitro explosion—sweeps him over the edge to his demise. Despite their best efforts, the avalanche film crew managed to capture only one shot for this second avalanche sequence—a view of the avalanche thundering toward Cyril, which combined separately photographed elements. The visual effects team enhanced this initial shot and created two others from scratch. "The first shot is from the avalanche's point of view as it moves towards Cyril on the edge of the cliff," explained Houston. "We added a lot of particle animation to that live avalanche shot to make it work. Then we have a low-angle view looking up at Cyril just as he is blasted off the edge, which was a combination of a stunt fall shot against bluescreen in New Zealand, a miniature cliff with a Monique puppet attached, and a miniature avalanche effect that was done in Los Angeles." Cinema Production Services created the model elements for the shot, setting up a nearly twenty-foot-tall version of the cliff, then pouring baking soda—doubling for

snow-down a chute and over the miniature, all the while filming at 120 frames per second. “That gave us a very good shot of the avalanche bursting over the cliff. We treated it digitally to thicken it up a bit, then added the stuntman doing his jump.” The final shot is a high, wide angle showing the aftermath of the avalanche. “The bulk of that shot was particle work, although it also included elements shot on the wall set and additional miniature effects.”

With one member of the rescue team now dead, Annie, Vaughn and McLaren are rapidly succumbing to altitude sickness within the ice cave. In desperate need of more dexamethasone, Annie braves the instability of an ice bridge made up of debris from the first avalanche in order to reach a half-buried pack of supplies. As she makes her way back over the chasm—supply pack in hand—the blast from the distant nitro explosion causes the ice bridge to collapse beneath her feet. With a final lunge, Annie makes it safely to the other side.

Neil Corbould’s crew built the fifteen-foot-long collapsible bridge into the ice cave set, first modeling it in the computer. “We showed the computer version to Martin, and he liked it,” remarked Corbould. “So we built it for real on the stage out of poly styrene, foil and resin that was colored white, then topped off with wax to give it an opaque look.” Hydraulic mechanisms operated remotely caused the construct to collapse on cue. “Each large chunk of ‘ice’ rocked a bit as Annie walked across it. On cue, we would release one of those chunks, and that would release the whole mechanism.”

Back on the mountain slopes, Peter learns that the nitroglycerine being carried by each climbing pair is unstable and will combust upon prolonged exposure to sunlight. Finally understanding shouted warnings from Peter, on the other side of the mountain, Malcolm and Kareem move their nitro pack into the shade—unaware that the syrupy explosive is leaking onto the snow, edging ever closer to the bright sunlight. Corbould and his pyro team created the resulting explosion in one of the government-authorized areas, while Peerless Camera provided a small digital insert of Kareem and Malcolm being vaporized in the blast.

Peter—having finally arrived at the site where Annie, near death, is entombed—blasts open the cave with the remaining nitroglycerine. On another location approved by the New Zealand government, the production filmed a series of explosions rigged by Corbould and his crew. Measuring up to 150 feet high and forty feet wide, each blast consumed forty gallons of fuel. “It is quite hard to do an explosion in the snow,” Corbould commented, “because the snow is so wet, it puts out the flame. We had to go for bigger and bigger explosions to get the look Martin wanted.”

The mouth to the cave collapses and, in a scene mirroring the movie’s opening, all five survivors of the K2 disaster wind up hanging from a single rope—until Wick severs the rope above his head, sacrificing his and Vaughn’s lives to save Annie, Peter and Monique.

The professionalism of every department and cast member involved in *Vertical Limit* transformed a potentially dangerous, frustrating and overlong shoot into one that ran like a Swiss clock. To a man and woman, cast and crew members met their dead lines, kept their morale high, kept their tempers in check—in short, they got the job done. “Everybody, including the actors, knew exactly what they had to do,” Campbell praised. “It was a very rigid process in which everybody stuck to the rules.”

Kent Houston and Tricia Ashford reached for that same level of precision and organization in the effects as they set out to prove the core tenets of their new company in its feature film debut. “We wanted to show that we could manage—technically, administratively and creatively—a big show in a very efficient manner,” Houston commented. “We did some great things in terms of shot management and visual effects management that enabled us to do this show very cost effectively. And we were fortunate in having two exceptional subcontractors working with us. In the future, should we need to spread a show out over many more companies, we feel confident that Anohana has the infrastructure to deal with that efficiently and well.”

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DEVIL'S WORK

ARTICLE BY E.TELLE SHAY



Faustian lore abounds in both cinema and literature, but one savagely funny take on that age-old theme was the 1967 movie *Bedazzled*. Smartly directed by Stanley Donen and showcasing the comic genius of Dudley Moore, the story revolved around a short-order cook whose unrequited love for a waitress at a burger restaurant makes him the perfect foil for the hilarious machinations of the Devil, played by Peter Cook.

Longtime fans of that movie, director Harold Ramis and producing partner Trevor Albert decided to tackle a remake of the Mephistophelean comedy, aiming to give it a modern, edgier spin. In the updated adaptation—written by Larry Gelbart, with Ramis and Peter Tolan—the unsuspecting patsy is Elliot Richards, a nerdish computer technician and social reject, while the Devil, in a gender-bending twist, is a naughty temptress in slinky red leather, stiletto heels and a killer ‘come hither’ smile. From there, the story loosely follows the original, with Elliot signing away his soul in exchange for seven wishes—all of them aimed at winning the affections of a coworker with whom he is smitten. But as each of his fantasies goes terribly wrong, Elliot comes to realize that the Devil, not surprisingly, has a wicked sense of humor.

Assembling a distinguished support team that included director of photography Bill Pope, production designer Rick Heinrichs, makeup artists Ben Nye, Jr., Robert Holloway and Matthew Mungle, and special effects coordinator Alan Lorimer, Ramis also turned to award-winning effects maestro Richard Edlund for visual effects supervision. *Bedazzled* would mark Edlund’s first movie assignment since the closing, two-and-a-half years ago, of his own Boss Film Studios, following a long and successful run. The assignment would also mark his second collaboration with Ramis, the two having teamed previously on *Multiplicity*. “Harold is a great comedy director,” Edlund observed. “Though he’s not entirely comfortable in the world of effects, he has an extremely discerning eye for what works and what doesn’t. It’s always fun working with him.”

Joining Edlund at the production level were visual effects producer Tom Peitzman, co-visual effects supervisor Ron Simonson and visual effects coordinator Kim Doyle. The production team then enlisted the services of Rhythm & Hues, where digital supervisor Mark Rodahl, art director Michele

Moen and compositing supervisor Harry Lam oversaw most of the film's visual effects— some 130 shots involving mostly bluescreen compositing, along with 2D and 3D computer graphics. Independent miniature work was provided by Grant McCune Design, with pyro techniques supplied by Joseph Viskocil. Also brought on board were Tom Woodruff, Jr., and Alec Gillis of Amalgamated Dynamics Incorporated, tasked with makeup and creature effects.

Bedazzled begins with a view from overhead as swarms of commuters hurry to work amidst the monolithic structures of San Francisco's business district. Time-lapse images of pedestrians scurrying about in blurred, half-second-per-frame exposures are punctuated by occasional freeze-frames of individuals in the crowd, identified by humorous descriptions of them that pop on and off the screen. When at last the camera settles on Elliot Richards (Brendan Fraser), the labels come fast and furious —'desperate...eager to please...lonely.' Moving at normal speed amidst the time-lapsed crowds, Elliot arrives at his place of employment, Syneddyne, and opens the door for a female coworker, only to have thousands of other time-lapsed employees stream past him as a new label—'doormat'—pops on the screen. To achieve the desired effect, the non-time-lapsed Fraser was filmed against greenscreen and inserted into the speed-blurred backgrounds at Rhythm & Hues.

Oblivious to the rebuffs of his coworkers, Elliot forces his way into an after-hours get-together at a local bar, where he spots Alison Gardner (Frances O'Connor) and murmurs to himself that he would give anything to have her in his life. Suddenly, a cue ball comes sailing off a nearby pool table, rolls across the carpet under the legs of patrons seated at the bar, and lands at Elliot's feet. Glancing up, Elliot is startled to see a seductive-looking woman in red (Elizabeth Hurley)—revealed in a crash-zoom shot—beckoning him from across the room. Returning the ball to her, Elliot watches in amazement as she proceeds to run the table with just a single deft stroke. The rolling cue ball and subsequent tabletop trick shot—which Edlund designed—were executed at Rhythm & Hues via CG pool balls animated by 3D digital artist Mike Roby. Digital compositor Sean Lee assembled the shots, incorporating interactive shadows and reflections on both the moving balls and the carpet.



In Bedazzled—a Harold Ramis comedy—Elliot Richards (Brendan Fraser) sells his soul to the Devil (Elizabeth Hurley) for seven wishes, all of which backfire. Visual effects supervisor Richard Edlund engaged Rhythm & Hues to create effects for the film, which included matte paintings that placed the satanic DV8 Club in San Francisco.

Elliot is understandably skeptical when the beguiling woman identifies herself as Satan and offers to help him take control of his life and gain the affections of Alison. Accompanying her to a raunchy disco—appropriately called the DV8 Club—Elliot finds himself the center of attention as revelers on the dance floor give him a hero's welcome. Nighttime exterior views of the club were filmed in *San Pedro*.

To suggest a San Francisco locale, digital matte painter Chris Consani, working under the supervision of Michele Moen, painted the Oakland Bay Bridge. 2D artist Jason Greenblum then composited

and tracked it into the background of the shot. "That was kind of a scary shot, when we first saw it," recalled Harry Lam. "I was thinking: 'Can we pull this off with a 2D matte painting, or do we need to actually build a 3D bridge?' The difficulty was that the camera move at the end of the shot had a bit of a boom and a tilt, and to do it in 2D we had to lock multiple points on the back of the bridge to the city background. The front of the bridge is locked to the foreground, and the bridge itself is skewed. So it was a 2D cheat made to look like a 3D camera move. We tracked multiple layers of lights on the bridge, and put lens flare back on top. Jason did a great job with multiple-point tracking and 2D skewing to cheat the perspective."

Inside the seamy DV8 Club—a two-story set designed by Rick Heinrichs to suggest the underworld—the Devil ushers Elliot into her private office and produces a contract for him to sign, offering seven wishes in return for his soul. To convince him that the contract is authentic, she briefly demonstrates her magical powers, transforming before his eyes into a more traditional-looking red devil dressed in tails and complete with horns. As originally scripted and filmed, the transformation scene had entailed a more elaborate effect in which the Devil morphed into not just one, but a rapid succession of incarnations, including one that resembled the Wicked Witch of the West, another that was a satyr-type goat creature and, finally, a twelve-foot-tall fiend with horselike legs and hooves.

Tom Woodruff and Alec Gillis were called upon to create the practical creature effects. "Harold had made it very clear from the beginning," remarked Gillis, "that since this was a comedy, and we would be dealing with images that really weren't going to be on screen for very long, he wanted to stay within classical archetypes of the Devil. So the satyr-type design was something we cobbled together from ancient woodcuts—the kind of creature that came originally from Greek mythology, but was adopted in the Middle Ages as a man-beast devil with horns and goat legs. The twelve-foot demon was an even more classical depiction of the Devil, harking back to the creature from the 'Night On Bald Mountain' segment in *Fantasia*."



Bluescreen footage of Fraser on a helicopter skid was composited into aerial plate photography for a sequence in which Elliot, wishing for wealth and power, is turned into a drug lord.

On the live-action set, the satyr was portrayed by Woodruff in a full body suit, with prosthetic legs and a single-piece facial appliance. “Harold didn’t want us expending a lot of time and money articulating any aspect of the face,” Woodruff observed, “so the eyes were completely non-moving—which gave the creature a creepy, staring look, but very animalistic. We wanted the legs to have the proper configuration for a goat leg—kind of that Harryhausen cyclops look. To make that work, I had to sit on a rig that was based on a boom support arm, and we counterweighted it so I was able to take my own weight and allow the legs to flex at the proper joints. I could raise myself up and down, and actually take steps if I wanted to walk along the arc of the radius of the boom arm—though that ended up not being necessary.”

For the twelve-foot demon, Gillis and Woodruff transformed bodybuilder Lou Ferrigno—a former Mr. Universe and title player in *The Incredible Hulk* television series—using a combination of full-body makeup and prosthetics that included finger extensions and slip-on horse legs that were much larger than the goat legs of the satyr creature. “We opted to go with a sort of Clydesdale look for the demon legs,” noted Gillis, “because it was so appropriate for Lou’s build. He’s six-foot-six and 285 pounds—just enormous, and in phenomenal shape. We were really impressed with his physicality; and once he got this scary-looking demon face on, with contact lenses and teeth, it became even more imposing. We called him ‘Luciferrigno.’”

Though captured on film, most of the demonic manifestations never reached final compositing, as Ramis, intent upon tightening the story, decided to trim the sequence during postproduction. The final scene, assembled at Rhythm & Hues, would reveal only the transformation from Hurley into the stylish red devil—a makeup provided by A.I. on-set artist Bill Corso. “Elizabeth and the actor playing the red devil were both filmed against blue screen so they could be inserted into the background,” explained Harry Lam. “A fire effect along the leading edge of the transformation was a pyro element shot against black and matted in. Digital compositor David Gutman used the cape element as the wipe; so as Elizabeth spins, the cape reveals the upper part of the red devil—with a fire element—while the bottom, below the cape, is still her.”



For a scene in which the Devil demonstrates her darker side, Amalgamated Dynamics provided creature effects which were deleted in post when the sequence was trimmed back.

When a giant video screen in the Devil's office offers up images of Alison as further inducement, Elliot is at last persuaded to sign on the dotted line. His first wish—to be rich and powerful and married to Alison—instantly lands him in the opulent bed room of a lavish mansion somewhere in the jungles of South America, where he awakes to find Alison sleeping by his side. Examining his reflection in a mirror, Elliot discovers that he is now a Latino with thick dark hair and a hook nose—a Colombian drug lord, in fact, though he has yet to realize it. Makeup effects for the drug lord character—and for all of Elliot's subsequent alter egos—were created by Ben Nye, Matthew Mungle and Robert Hallowell. “It was definitely a collaborative effort,” said Mungle, who had previously worked with Ramis on *Multiplicity*. “Robert did the hair, Ben did the make up, and I applied any prosthetics that were needed. For the drug lord, we applied a darker skin tone to Brendan and changed his nose to give him a dramatically different look. That, plus a bushy mustache, brown contacts, wig and straight white teeth veneers helped quite a bit.”

Wandering onto a balcony, Elliot delights in a breathtaking view of his magnificent estate. As the scene was actually filmed in Santa Barbara, digital paint work was required to remove other homes visible in the shot. "Jeffrey Castel De Oro used Illusion to track little patches of greenery to cover up the houses," noted Lam, "and little pieces of ocean to cover up an oil rig that was floating offshore. It was difficult matte work, because Brendan's hair actually crossed over one of the houses; so when we patched in the green, we had to be careful how we matted his hair back in."

Before long, Elliot discovers that things are not quite what they seem. Not only does Alison despise him, but his wealth is derived from drug trafficking. When his men turn against him during a drug deal gone sour, Elliot bails out of the ensuing pandemonium by grabbing onto the skid of a departing helicopter. Shots of Fraser dangling from the skid were filmed against a bluescreen and composited into background plate photography of the real airborne helicopter. "We added extra movement of the helicopter in the plate to give a little more energy to the shot," stated Lam, "and we also added sparks on the skid to represent the bullet hits."

Clinging to the skid with one hand, Elliot pulls out his pager—a device given to him by the Devil should he desire to terminate a wish. When it slips from his fingers, he lets go of the skid and plummets, managing to catch the falling device and dial '666' just seconds before impact with the ground. "There are some shots of the fall where you actually see the helicopter at the top of the frame," noted Lam. "Those were done with a stuntman on a cable, jumping out of a real helicopter. Mike Frevert and David Sweeney then painted out the cable and a rig on the helicopter that the cable was connected to." For an over-the-shoulder shot of Elliot trying to catch the falling pager, compositors combined a blue screen element of Brendan, a separate blue screen element of the pager, and background plate photography of the fast-approaching ground. "The background was shot with a special spring-wound camera Richard Edlund had. When we composited the shot, we reversed the plate action, added some extra motion blur, and skip-framed it so it looked like the ground was rushing up towards Elliot." A reverse-angle closeup of Elliot's face moments before impact included the helicopter, still visible in the background. "The helicopter was on a separate plate, and we scaled it to give a sense of movement so it looks as if Elliot is actually free-falling away from it."

Assuring Elliot that no one gets it right on the first try, the Devil transports him to Alison's apartment where he searches for clues as to her notion of the ideal man. Gaining insights from her private journal, Elliot next asks to be transformed into the most emotionally sensitive guy in the world, but winds up as an ultra-wimpy, poetry-spouting bore. Making Brendan Fraser into the sensitive man entails raising the actor's hairline with a bald pate, then adding an unruly red wig. "In keeping with the red hair color, we went for a fair complexion, with freckles—kind of a naive look," recalled Matthew Mungle. "I suggested to Ben Nye that we do a vacuum replica of Brendan's face and that he then drill



Elliot's wish to become a basketball superstar is fulfilled. For a slam-dunk leap from the three-point line, Fraser was flown from a wire rig that was erased digitally in postproduction.

holes in it wherever he wanted the freckles to be.” The vacuum template proved useful, assuring continuity as Nye airbrushed on the freckles during each day’s makeup application. Green contacts and small teeth with prominent gums completed the look of the character.

When Alison dumps her overly sensitive beau in favor of a more macho type who kicks sand in his face, Elliot terminates wish number two. Heeding a suggestion from the Devil that he make his wishes more specific, he next opts for fame and fortune as a professional basketball player. In a flash, the scene shifts to the Los Angeles Forum where an NBA game is underway, and seven-and-a-half-foot-tall Diablo superstar Elliot Richards is about to enter the arena.

“Of all the characters, this was definitely our most outrageous,” stated Mungle. “We were going for a combination Dennis Rodman/Michael Jordan type look. Brendan said he wanted a flattop, so we had Stuart Artingstall create a blond wig for him. We also wanted to make his head look bigger, so I sculpted a baldcap for him to wear underneath the wig that was wider on the sides and a little taller. Then, to make his eyebrows look more Neanderthalish, I did a forehead-eyebrow prosthetic piece that covered his real eyebrows, so we could apply fake ones that were thicker and denser. Also, Brendan has rather small ears, so we enlarged them a bit.” Completing the look were sideburns and a goatee, brown contact lenses and gnarly teeth with a gold cap on one. Accessories included extensive body tattoos and an earring.

Mungle also fashioned a special baldcap for Fraser to wear during a postgame courtside interview scene in which Elliot drenches both himself and a reporter in torrents of sweat. “The baldcap had flat tubing built into it,” stated Mungle, “with little sections cut out so that water could flow out of it. It was connected, through a tube running down Brendan’s back, to Hudson sprayers that we filled with water and pressurized so we could stop and start the flow as needed.”

The basketball sequence, filmed at the actual Los Angeles Forum, was the scene Ramis had been most anxious about, since the six-foot-three Fraser would need to appear seven-foot-six on film. Fortunately, Richard Edlund was a whiz at just the kind of complicated motion control camerawork required to pull off the illusion. His strategy was to shoot the full basketball action first, minus Fraser, then film the actor performing his part of the action against bluescreen, with the camera moved in closer so that he appeared taller. The approach called for precise mathematical calculations and recordkeeping in order to orient the cameras correctly to allow for scaling up the image and inserting Fraser into the shots with the proper distortion. “As long as our



To make him appear seven and a half feet tall, Fraser was photographed against bluescreen and composited into precisely choreographed plate photography of the other players.



plan was correct, it was just a mathematical thing,” Edlund observed. “We figured out that we had to scale Brendan’s height up to 120% in order to make him appear seven feet six inches tall. That meant we had to shoot him from a distance that was 83% of what you’d normally expect. So whenever we were filming Brendan, we had to move the camera closer to him by 83%. If we were ten feet away from him at his normal height, for example, we had to be eight feet three inches away in order to scale him up. We also had to scale the height of the camera.”

In-camera forced-perspective was used to suggest Elliot’s extreme height in a post-game interview.

Working with former Lakers ace Norm Nixon, hired by the production as a consultant, Edlund first choreographed the action, performed by real basketball players, both professional and amateur, recruited for the show. “Those were our ‘A’ team guys,” said Edlund. “We used six-foot-plus players instead of seven-footers so that Elliot would look quite a bit taller than everybody else on the team.” Typically, Edlund would have Nixon set up the play, using a seven-foot-tall stand-in for Fraser. Then he would capture the action on video as a reference take. “Next, we would film the scene with just the ‘A’ team guys doing what they were supposed to do. Basketball players are pretty good at repeating things because they’re used to working out plays; so these guys had an innate sense of timing. We’d double-expose the two takes with on-set video to make sure the background action matched what was done in the reference shot. Later, when we shot Brendan against bluescreen—on a different day—we’d have the camera angle worked out carefully so we were pointing in the right direction, with scaled tape marks on the floor so Brendan knew exactly where he needed to be at any moment. After each take, we’d superimpose his performance over the video of the stand-in, whose moves he was mimicking, to make sure his actions and his eyeline and his timing all matched.” At Rhythm & Hues, Mark Rodahl and his team then composited the footage of the oversized Fraser with the other normal-size basketball players, adding appropriate reflections and shadows on the highly reflective floor.

While quite a number of shots would be done in this manner, to fully sell the illusion of Elliot’s extraordinary height, Edlund also wanted scenes that showed him interacting directly with the other players. “We figured there would be instances in which we needed to see him jostling other players and actually making baskets,” explained Edlund. “So we had another set of basketball players that we called the ‘B’ team, who were all shorter—most of them were five-foot-seven to five-foot-ten—and we photographed Brendan, or another stand-in for him, interacting with them and with an 83% custom-made ball and an 83% hoop built by Al Lorimer, the physical effects coordinator on the show. That way, there was no need to composite Brendan with the other players.”

Regardless of the approach selected for any given shot, all but a handful of them were photographed motion control so that the game action could be composited into background imagery of the packed stadium. This was necessary because the thousand or so extras hired to serve as spectators filled only one section of the Forum. To pack the stands, the extras were grouped in one section and photographed, then moved around the arena for additional passes. In post production at Rhythm & Hues, the various passes were tiled together and composited behind the court action to impart the illusion of a full house. “Richard and Ron Simonson used blackscreen behind the players and the cheerleaders on the court,” stated Harry Lam, “because they didn’t want blue screen reflecting on the shiny basketball floor. So we did a luminance key off



Makeup team members Robert Hallowell, Ben Nye and Matthew Mungle created special looks for each of the characters Elliot becomes in the course of his ill-fated wish fulfillment.

the black and additional roto when we needed to—for instance, on some of the strands of the pom poms the cheer leaders were holding and waving. Then, usually, there were several crowd plates that had to be split-screened into the composite.”

A shot of Elliot entering the arena and stopping to sign an autograph book extended by a young fan in the stands, provided a particularly difficult hand off from one element to the other. “This is the first time you see Elliot as a seven-footer,” recalled Lam, “so Brendan was shot separately emerging from a bluescreened set piece, with the camera moved in 83% so that when digital compositor Lisa Pollaro inserted him into the shot he appeared taller. But the hard thing was getting the hand-off of the autograph book to look right, because the kid was on a different pass and Brendan was actually handing off the book to a C-stand. When it was shot, the action matched really well, timing-wise, but in order for the book to flow just right from Brendan’s hand to the boy’s, we still had to do extra Elastic Reality work. Berta Garcia was responsible for that transition, with assistance from Mike Frevert, who provided additional paint work.”

A tip-off gives Elliot control of the ball as the game resumes. A high-angle shot of the jump was captured—in two separate passes—by a camera mounted just under the arena’s Jumbotron. In one pass, the referee and the players pantomimed their motions, minus the ball. Then Fraser and the ball were photographed in a separate bluescreen pass, with the camera moved down to 83% of its original height. At Rhythm & Hues, 2D digital artist Jeremy Nelligan assembled the layers. “It was timed well on the set,” remarked Lam, “but we had to do additional tracking to make sure the ball really looked like the referee was bringing it in. There was a lot of shadowing involved.”

Among the dazzling maneuvers performed by the cocky Elliot is one in which he leaps high into the air to land a basket from the three-point line.

“Everybody knows Michael Jordan can leap from the free-throw line and slam dunk the ball,” Edlund stated, “so we had Elliot leap from the three-point line and do the same.” Using other players to set up the play, Edlund choreographed Fraser receiving the ball and bounding into the air, then traversing a huge distance across court before his feet touch down. “We had Brendan on a wire rig for that part of the shot. John Moio, who was the stunt coordinator, set all that up and had his team manning the wires. We shot the leap in slow motion, then cut to a view of Elliot from under the basket as he grabs the hoop and slam dunks the ball.” The force of the action shatters the backboard, showering Elliot with glass shards, one of which he spits out towards camera. “That was done a couple of different ways. In one pass, we actually broke the glass; and in another we took chips of silicone rubber that looked just like glass shards and dumped those onto Brendan from off-screen.” At Rhythm & Hues, wire removal on the shot was performed by rotoscope artist David Sweeney, and the multiple passes were composited by Jeremy Nelligan.

In another grandstanding play, seen in a wide shot, Elliot tosses the ball from half court to score a basket. “Jonathan Robinson composited the shot,” Harry Lam stated. “Even though production used a stand-in for Brendan, they filmed him against blue screen and had the foreground players on a separate pass; so we had to finesse the ball between the two passes at some point, to switch from one ball to the other. The interesting thing was that this stand-in—who was a really good basketball player—actually made the shot. Unfortunately, the ball got stuck in the hoop, and we had to add a CG ball to continue traveling through it. Also, when the stand-in made the shot, the real ball arced out of frame—which made the play look like a cheat, even though it was



not. So Richard had us do an extra digital tilt and put our CG ball in frame to keep it in the shot.”

Makeup applications transformed Brendan Fraser into a South American drug lord, the world’s most sensitive guy and Abraham Lincoln.

Following the game, Elliot submits to a locker room interview by Ali son, who is clearly fascinated by his unusual height and what she assumes must be his other equally prodigious asset—an assumption that turns out to be dead wrong. For wide shots in the scene, Fraser was once again filmed against bluescreen with the camera pushed in 83% to make him appear larger. “We filmed Frances’ part of the scene first,” said Edlund, “and played that back on a video monitor so that Brendan could play to her performance. Then we matted him into the shot.” Most of the scene, however, was done using simple forced perspective, with Fraser in the foreground—visible in over-the-shoulder shots or from the waist up—standing on an apple box so that he appeared to tower over O’Connor, who was positioned further away from the camera. To ensure that eye lines and dialogue would sync up, Edlund worked out a way of having each actor see the other’s performance. “It was a little teleprompter-type system where each actor looked through a fifty-fifty beam splitter. Reflected on the beamsplitter, from below, was a video monitor of the other actor. So the first actor could relate to the second, and both could appear to be looking each other in the eye.”

Growing increasingly desperate as each of his wishes self-destructs, Elliot finally asks to be made president of the United States, hoping to at least accomplish something significant. Moments later, he finds himself incarnated as Abraham Lincoln. Character makeup for the sequence proved to be one of the most challenging for Mungle, Nye and Hallowell, given the differences between Lincoln’s gaunt face and Fraser’s full one. Using as reference an actual lifecast of Lincoln, Mungle created facial prosthetics that included bigger ears and pieces designed to make the actor’s cheekbones appear higher. “They covered the cheeks and continued up into the sides of the nose area,” stated Mungle. “I didn’t go down to his jawline, because Brendan has such a prominent one that I didn’t want to widen it any more. Adding a beard helped us there, because it diminished his jawline.” A consult with make up legend Dick Smith helped impart a bit of historical accuracy to the presidential nose. “I knew that Dick had done quite a few Lincolns during his career, so I called him up. One of the tips he gave me was that Lincoln’s nose was deviated; and when I went back to the face cast, I could see it. The nose wasn’t perfectly straight the way it’s always drawn—it turned a bit. So I sculpted that into the nose we did, adding just a little deviated-septum turn to it.”

Once again, the Devil puts her own subversive spin on the wish, sending Elliot back into history to the Ford Theatre, on the very night Lincoln is assassinated. Bailing out mere seconds before the assassin’s bullet finds its mark, Elliot returns to the present, making his way back to the DV8 Club the next morning for a final confrontation with his tormentor. As with the night time shot of the disco exterior, the daytime view featured a matte-painted Oakland Bay Bridge in the background. “The day shot was easier than the nighttime view,” recalled Harry Lam, “in the sense that the camera doesn’t move in this one. But because it’s daytime, you see more of the bridge, and you see it more clearly. In addition, there were telephone wires in front of the bridge, and a couple of birds flying by; so there was matte work we had to do. Chris Consani painted the day shot first to set up how the bridge would look, then changed it to night time and added lights for the other shot.”

In the light of day, the DV8 club interior seems more sinister, and its occupants aged and decrepit. Character makeup effects for both day and night scenes were done by Amalgamated Dynamics.

“For the night scene, we did three demonic waitresses,” recalled Alec Gillis, “which involved fairly simple appliances, teeth and contact lenses to make the women look sort of feral and beautiful in a threatening way. Then, when Elliot returns, and the club is revealed in its true form—which is really hell—we did a couple of older ladies, one with gigantic, pendulous silicone breasts.

“We also did an ancient woman makeup that involved a whole neck and upper chest appliance,” Woodruff continued, “which gave the actress this enormously widened neck, with all the tendons and the musculature visible. Across the chest, we added a one-piece appliance that showed skin pulled so taut that you could see the ribs and the whole bone structure of her ribcage underneath. It was fun because the woman in the role had very tight facial skin; so it looked like a terribly vain woman whose body has gone to hell, so to speak, but whose face has been lifted cosmetically.” Those on-set applications were headed up by Bill Corso.”



Elliot finds that the revelers at the DV8 Club are, in fact, denizens of hell. Amalgamated Dynamics created grotesque makeups for some of them.

Inviting Elliot back into her office at the club, the Devil walks behind a screen and, without pausing, emerges in a white angel Halloween outfit, complete with halo. Jeremy Nelligan composited the shot, done as a split-screen filmed in two motion control passes. “To create a smooth transition between the two shots,” said Harry Lam, “we took the element of her halo and kind of translated it into 2D animation so it would look like you’re seeing the top of her head with the halo bouncing along behind the screen as she walks. If we had just transitioned between the two, it would have been a little too abrupt.”

Elliot refuses to make his final wish, thereby incurring the Devil’s wrath and setting in motion the film’s climactic sequence. The action begins with the office blowing apart—achieved as a miniature effect at Grant McCune Design. The floor beneath Elliot’s feet gives way, and he is left standing on a pinnacle, one of several spiraling up from the burning pits of hell, now visible below him. While Fraser was filmed against bluescreen on an elevated set piece, the views of hell were done as an elaborate digital matte painting by Michele Moen. In keeping with Ramis’ vision, Edlund had sought a classical, slightly stylized interpretation of hell that would be keeping with the film’s comic tone, without going overboard. “Harold wasn’t looking for a boiling pot of humans,” Edlund remarked. “We looked at the Gustav Doré etchings in *Dante’s Inferno*—classical images of hell—and from those got the idea that what we wanted was a tasteful representation, not goofy. So there are cauldrons of lava at the bottom of the pit, and lots of fire bursting up from subterranean, hellish depths—almost like looking down from Monument Valley at those needle formations that stick up.”

“I did a 180-degree hell concept,” Moen noted, “and we showed that to Rick Heinrichs. He did a sketch, making it more of a concrete design, with definite rock shapes, which set a firmer direction for the painting. Then I painted the whole thing in many, many layers, so we could cut into the layers for all of the different camera angles and lenses.”

Compositors matted as many as a dozen different layers of painted and practical elements into the 2D environment, including haze and smoke, fiery explosions, various rock formations and pools of molten lava. “Richard shot a lot of pyro elements, some of them specific and some that were more generic, to use for different shots in the sequence.

He had some great footage of this petri-dish stuff that looked like bubbling lava. He wanted to use some of that as a fire element, then add little fire pools and firefalls—like waterfalls—scattered around in the rocky pit.”

At Ramis’ bidding, Moen also incorporated a suggestion of heaven in the form of a smoky blue light emanating from above, for up-angle shots. Interactive lighting added depth to the scene, illuminating various rock layers as the flames explode upwards. “It would have been nice to build some 3D rocks and get the lighting and shadows from that,” Moen said, “but by the time we got all the plates for the sequence and scanned them in, we had to go into production. It was a quick deadline.”

With the disintegration of the office, the Devil abandons her curvaceous form in favor of something more terrifying. As originally scripted and filmed, the sequence had Hurley transforming first into the twelve-foot-tall Lou Ferrigno creature, then into a forty-foot-tall winged demon. Lifting Elliot into the air on a giant trident, the demon demands that he make his final wish or die. Selflessly, Elliot wishes a happy life for Alison, then plummets toward the fires of hell as the trident dissolves under him. For the winged demon, A.I. designed and built another creature suit, to be worn by Tom Woodruff and puppeteered on the set. “The idea was that this creature is a product of its environment—not only is it in hell, it is hell,” Alec Gillis stated. “So we made it a lava creature, as if its insides are this boiling, burning pit of molten magma and lava. The outer skin is blackened and cracked; and through the cracks, as it moves, you see the glowing lava from within. Jordu Schell was involved in the design work for the character, and Steve Wang did a lot of the sculpture on the body, with all the proper fissures and opening cracks.”

While the outer surface of the suit was painted black, the inner recesses were painted with a fluorescent paint, custom-blended to emit the proper orange and yellow glow of molten lava. Adding an eerie effect to the demon’s expression were movable eyes. “Harold wanted the eyes to glow,” Woodruff recalled, “but we didn’t want to just put little LEDs in them. Nor did we want them to reflect light by putting in Scotchlite or something like that. So we used clear acrylic spheres for the eye balls, sanded and frosted them, machined them out and planted lightbulbs within, connected to dimmers. The outside of each eye was frosted except for a little area of the pupil that would let the

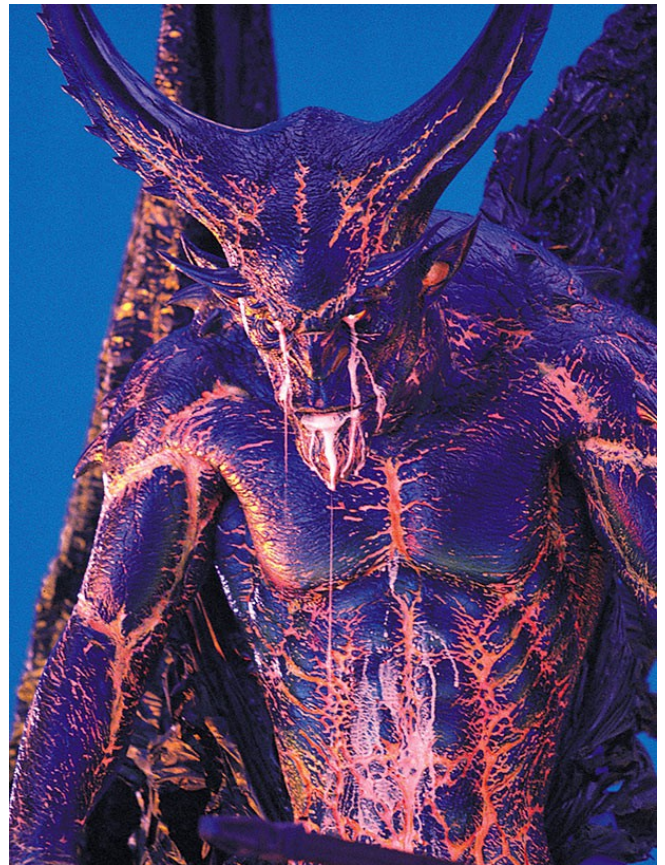


At the climax of the movie, the Devil is revealed in her true form as a winged forty-foot demon. Amalgamated Dynamics created an animatronic puppet for the scene. Rhythm & Hues replaced the puppet’s practical wings with CG replicas, then composited the beast, together with bluescreen footage of Brendan Fraser, into a fiery hellscape.

light emanate. So the effect changed, depending on the variance of the light. If it was turned up all the way, you'd see two little beams of light coming out of the eye; or you could back it off, and just give the whole eye an overall glow."

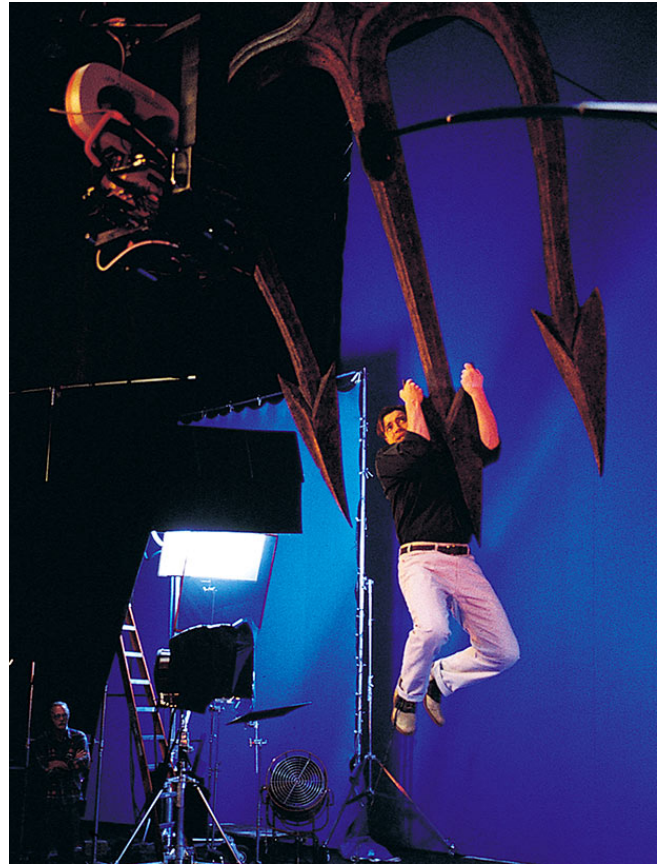
Giant wings—batlike in appearance—were fashioned out of a textured plastic sheeting. "The wings were an issue of concern with Harold," Gillis said, "and on the day of the shooting we bounced back and forth—do we shoot with the wings, or do we shoot without them and then add them digitally after the fact? Part of the problem was that because the schedule was so rushed, there wasn't time for us to come up with a mechanical system to operate the wings. We had to build them as light weight as possible so that puppeteers with rods would be able to manipulate them. Still, it was a huge wingspan for practical wings—about twenty feet across from tip to tip." On the bluescreen stage, the wing action was controlled by two A.I. puppeteers—manning counterweighted lines running from the top of the wings up to the rafters—while facial articulation and lip-sync were controlled by four others.

In postproduction, Richard Edlund had Rhythm & Hues roto out the practical wings and substitute in CG ones for a more dynamic look. Other digital enhancements included refining the lip-sync on the practical demon to better match the dialogue, and adding a ripple effect for the interior molten lava look. "We keyed the fluorescent red streams in the suit and used that to color-correct the lava," explained Harry Lam. "As the monster moved, the key would grab a slightly different part of the red and give it a little extra kick, so it looked yellower and hotter in places."



A change of concept for the finale resulted in all but one shot of the winged beast being replaced with a forty-foot Elizabeth Hurley.

Digital artists also replaced the prop trident used in the bluescreen shoot with a digital one for a shot of its crashing down on the rock where Elliot is standing. “We switched to a CG trident to give it a bigger impact,” noted Lam. “Unfortunately, there was a practical trident in the shot that Marc Nanjo spent weeks trying to get rid of with Elastic Reality and painting, so that compositor Cybele Sierra could put in our CG version.” Wire removal was required for subsequent shots of Elliot dangling from the tine of the giant trident as the demon lifts him into the air—executed on set with the actor hanging onto the full-size prop. “Marc Rubino did a bit of 2D animation with the trident to tie it in better with the motion of the demon raising his arm. Then, in the last shot, where Elliot falls from the trident, we did a 3D effect of the trident turning to ash. We took the trident that was shot with Brendan, and put a 3D particle effect on the 2D image. Geoff Harvey devised the effect and Tomás Rosenfeldt wrote the tools to achieve it.”



Fraser clings to a giant trident prop on a bluescreen stage.

Late in postproduction, Ramis made a decision to substantially alter the hell sequence, eliminating much of the A.I. work. “Harold was troubled because test audiences had not responded well to the scene,” said Edlund. “Then it occurred to him that maybe it was because Elizabeth Hurley wasn’t in it. Also, there was really no setup for the demon, since we had cut the earlier transformation scene. This was supposed to be a climactic confrontation between Elliot and the Devil, and all of a sudden audiences didn’t recognize the Devil in this creature. They expected to see Elizabeth, and instead it was this monster. It just didn’t work.”

Following an eleventh-hour reshoot with Hurley in Los Angeles, Ramis ordered the forty-foot demon replaced, in all but one shot, with a similarly scaled-up image of the actress clad in a snakeskin bikini. At Rhythm & Hues, Sean McPherson stepped in as digital compositing supervisor for the reconceived sequence since Harry Lam had moved on to another project. “Most of the hell sequence shots were comprised of three basic elements,” explained lighting director Pauline Ts’o. “There was the matte-painted background; there was Brendan Fraser; and there was—as it originally stood—the winged demon. So what we were asked to do was take out the winged demon element and put in Elizabeth. Technically, it was not that complicated, because the layers were already separate, for the most part; but the time frame we were given, of just a few weeks, made it a little more challenging.”

As Elliot plummets into hellfire, his surroundings go white and he lands instead on the steps of the San Francisco courthouse. Having regained her earthly form, the Devil advises Elliot that their contract has been rendered void because his last wish had been an unselfish one. His soul safe and secure, Elliot returns to his old life—and fortuitously finds a new love, one who looks very much like Alison, but finds him charming and adorable. In a final scene, a bookend to the film's opening, the two are seen strolling blissfully through a park as hundreds of time-lapsed people blur past them.



Clinging desperately to the giant trident, Elliot dangles over the fiery depths of hell as the Devil taunts and torments him.

Live-action for the segment was filmed at San Francisco's Marina Park. "It was at the end of Hyde Street, where the cable cars do their turnaround," recalled Edlund. "We set up the scene looking out towards Richardson Bay, and there was a boat in the harbor. The shot starts out at normal speed and does one of those speed-aperture changes so that, all of a sudden, everybody is moving at half-second frame exposure, just blurring by. I got the camera going just in time to catch this huge container ship speeding across in the background; so both it and the other boat are doing the twist out there in the waves. It looked quite comical. Then we put a huge, fifty-yard greenscreen out there to shoot Brendan and Frances walking at normal speed through the whole shot, along with a few other 'enlightened' or in-love folks, such as a Buddhist monk sitting on a bench, an old biker couple and some kids playing. By combining these two elements, the idea was to have all this frenetic activity—made up of time-lapsed people streaming back and forth—and in the midst of it all have Brendan and Frances and a few others just going at normal speed."

At Rhythm & Hues, Harry Lam and his crew isolated the non-time-lapsed people and composited them into the plate photography of the time-lapsed background action. The sequence proved trickier than the opening, as there was a lot of crossover between the two elements throughout much of the shot. "In the opening, pretty much everybody just crossed behind Brendan," Lam noted. "In this case, we had to come up with blurs for the time-lapsed people whenever they crossed in front of the non-time-lapsed ones. We couldn't just put them in at a percentage, because the background would also have shown through. So Jeffrey Castel De Oro used Illusion and Matador to paint in additional solid blurs that we could deposit back on top of the non-time-lapsed people. It had to be done almost on a frame-by-frame basis."

Despite a few bumps in the road, *Bedazzled's* journey to the screen had benefited from a friendly and cooperative spirit that started at the top with Harold Ramis and permeated through the ranks. "It was one of those great shows you get to work on every few years that makes you want to stay in the industry," said R&H visual effects producer Bruce Jones. "Richard Edlund understands film better than anybody; and what he brought to the party was his vision and his ability to figure out how to do it all, plus brilliant use of motion control. What we brought to the party was putting it all together and getting the look Harold was after, through matte paintings and CG enhancement."

For Richard Edlund, too, the return to feature filmmaking after a two-and-a-half-year hiatus was an exceptional experience. “There were times when I missed the resources of having my own company,” Edlund reflected, “and the camaraderie we had at Boss. Over the years we must have had thousands of employees come through our doors—damn near everybody in the business. But working with Harold on this picture was wonderful. He makes good decisions on the set, and he makes great decisions in the editing room. It was frustrating for him to have to cut a lot of scenes that had already been shot in order to make the movie work; but a good director knows when to cut his losses. I think Harold did a really professional job of keeping the comedy level up and the audience appreciation level up. Harold loves making movies and believes in a happy set. Some of the best times of my career have been on movies with Harold Ramis.”

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OUT, OUT, DAMNED SPOT

ARTICLE BY JODY DUNCAN



Four years after Walt Disney Pictures released its live-action version of *101 Dalmatians* – a remake of the beloved Disney animated feature based on a novel by Dodie Smith – a sequel featuring the return of fur-loving villainess Cruella De Vil and another generation of adorable spotted pups has appeared on the holiday scene. In *102 Dalmatians*, Cruella emerges from prison a changed woman and a supposed champion of animal rights. But with the disappearance of a trio of Dalmatian puppies – Little Dipper, Domino and Oddball – fingers point to Cruella and her dastardly cohort French furrier Jean Pierre Le Pelt.

In his first live-action outing, director Kevin Lima – who had previously directed Disney’s animated *Tarzan* – enlisted between sixty and seventy eight- to ten-week-old Dalmatians to portray Oddball, the movie’s canine star, during a six-month shoot at Shepperton Studios in England. That many animals were needed because each of the puppies could only be used for two or three weeks before outgrowing the role. The live-action performances of these canine actors, however, would not suffice to tell the entire story, a central point of which was Oddball’s spotless, all-white coat. Due to the fact that all Dalmatian puppies have their spots by the time they reach the trainable age of eight to ten weeks old, visual effects supervisor Jim Rygiel and Disney’s digital production studio, The Secret Lab, faced the monumental task of digitally removing Oddball’s spots for some 250 shots. In addition, co-visual effects supervisor Dan DeLeeuw would oversee the creation of twenty shots utilizing a fully computer generated Oddball.

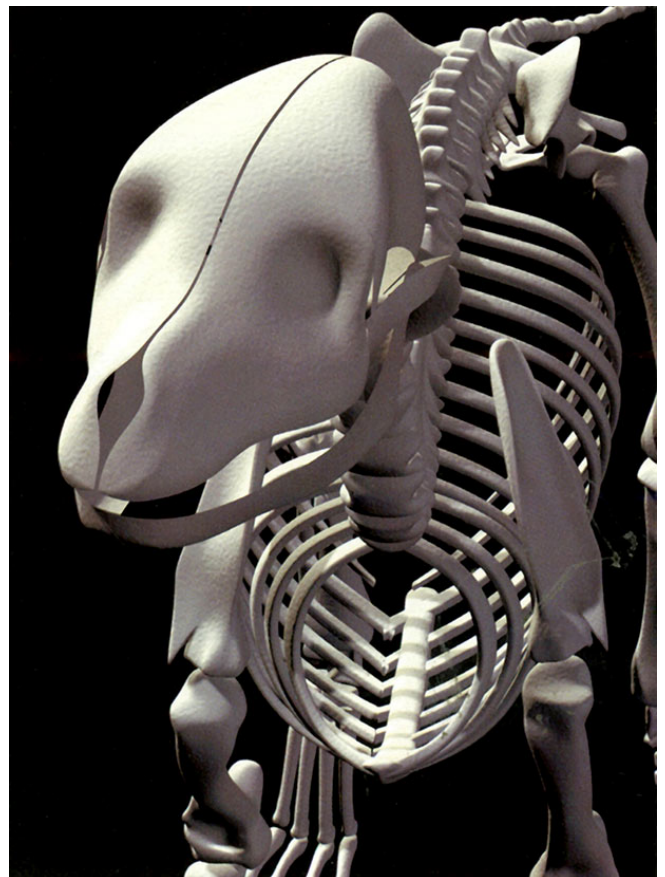
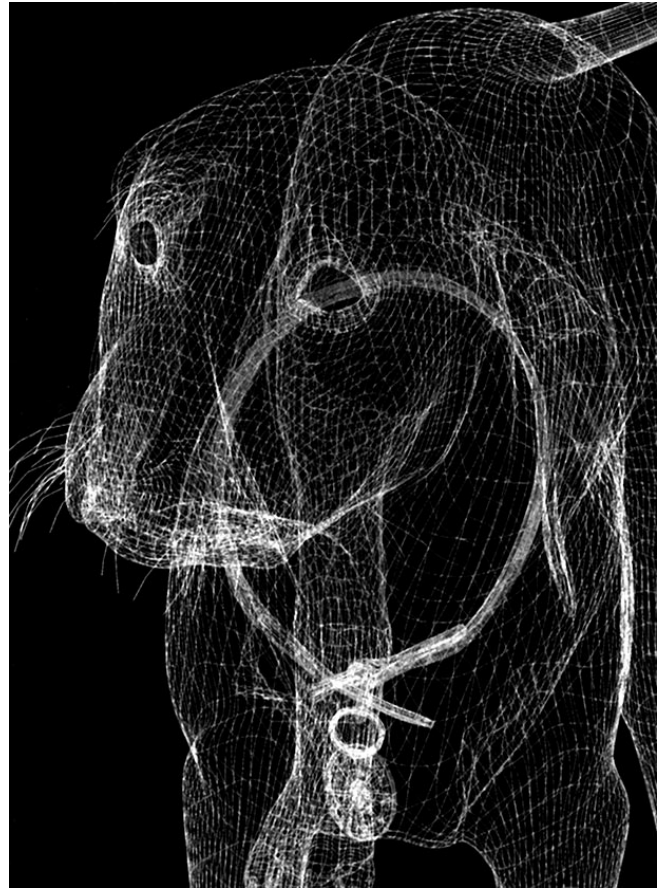
So potentially time- and labor-intensive were the frame-by-frame digital spot removals, production and effects personnel aggressively sought out practical solutions that might mitigate the need for the technique. “The first thing we did,” explained Jim Rygiel, “was try to figure out how we might not have to do spot removals – or, at least, not as many of them. We did some tests with white adult Jack Russell terriers – which were about the same size as a Dalmatian puppy – thinking we might be

able to use them in far backgrounds. But they moved differently than the Dalmatians; so we soon realized that wouldn't work."

Production also experimented with putting a puppy in a white spandex-type suit to cover up its spots. "The puppy not only had this suit on," stated Dan DeLeeuw, "but also little white muffs for his ears. But the puppy didn't like having all that stuff on. It wasn't hurting him at all; but in the footage, you could see that he wasn't happy wearing it, and he was walking funny. Looking at that test, it was like: 'Well, yeah, he's white... but he isn't walking very well.' It wasn't fooling anybody."

When these practical solutions proved unworkable, the Secret Lab team realized that it was going to have to remove Oddball's spots digitally – a task complicated by both camera movement and often frenetic live dog movement. The degree of difficulty of the job would depend largely on the number and size of black spots on the live dogs chosen to play Oddball for any given scene. "We pleaded with production daily to use dogs that were as white as possible," remarked Rygiel, who was on the set every day of the shoot. "That was our mantra throughout production: 'Whatever you do, use a white dog.' But, most of the time, there wasn't that option. Production literally went through every Dalmatian breeder in England to get these dogs – and whatever Mother Nature delivered, that's what we got. If the puppies were particularly black, we couldn't stop shooting; we just had to deal with it. But it made the job much harder. The worst, most black-spotted dogs were the ones that were used at the beginning of the shoot. Those were the first spot removal shots we got in; and because they were so difficult, they were also the last spot removals to be finalized. Toward the end of the shoot, we actually had some dogs with only three black spots on their entire bodies. We were thinking, 'Why couldn't we have used those dogs through the whole movie?'"

The actual spot removal technique was one-part procedural and one-part by-hand artistry. "The first step was to take a shot through a procedural, which would get rid of any straight-on spots," explained Rygiel. "We utilized Combustion by Discreet Logic, which could track individual spots, clone a white area next to each one, and fill it in procedurally. As long as the spot was side-on, pointed toward the camera, the process was fairly simple; but as soon as the dog started moving – which meant that the spots were moving and changing perspective – it became more complicated."



Oddball, the canine lead in 102 Dalmatians, is a Dalmatian puppy without spots. While most of the Oddball shots entailed the digital removal of spots from real Dalmatian puppies, a number of scenes required the creation of an all-CG dog. Modelers and animators at The Secret Lab crafted the digital pup, replicating real bone and muscle structure to insure anatomical accuracy. Particular attention was paid to outer details such as fur and eyes.

Ninety-five percent of the spot removal shots required a second, hand-painting phase. Compositing supervisor Brian Leach was in charge of determining which shots should go through procedural first and which should go directly to Sandy Houston's paint department. "The challenge was not so much in the individual approach for each shot" noted Leach, "as it was just the sheer number of shots we had to deliver."

"As a general rule," Rygiel noted, "they pushed all of the shots through procedural – because any spot that procedural could get rid of would help. Then the spots that were not straight-on to camera would be hand-painted out. We'd get spots piling up on the edge of the dog's body, for example, forming a kind of black line, just because of the perspective. It took an artist to paint those out and maintain consistency from frame to frame so the hair didn't chatter like something out of the original *Mighty Joe Young*. For each spot, we had to find a patch of fur next to it that was the same color, then clone it and track it, making sure all the hairs moved in the same direction. It had to be perfect."

The dog's ears, often flopping wildy throughout a shot, were especially problematic, requiring additional steps beyond procedural and paint. "We would rotoscope the ears utilizing Elastic Reality," said Rygiel, "then warp textures onto them, adding back in shadows and all the correct lighting. If the ears were moving too much in the frame for Elastic Reality to handle, we'd model and animate 3D CG ears, then track them to the plate."

One of the worst spot removal scenes, in terms of level of difficulty, was one in which Oddball rolls around on a copying machine, hoping to pick up some black ink that will give her a faux spotted coat. "The dog they used for that scene was particularly black," Rygiel remarked. "When I saw it on the set I thought, 'The crew back home is going to kill me when they see this dog.' Not only did it have a lot of black on it, it was rolling around all over the place. In most of the other shots, the dogs would stand there and maybe turn a little bit. But this one was flopping around as if it was on a rotisserie – which meant the spot perspectives were changing all over the place."

Though some were certainly more challenging than others, all of the spot removals represented new digital effects territory. "Nobody had ever done this kind of thing before," related Kevin Lima,



*For a shot in which Oddball and his parrot friend Waddlesworth watch the spaghetti-eating scene from *Lady and the Tramp* on television, the digital dog head was placed on the body of a live puppy.*

“at least, not on this scale. It turned out to be a huge job, much bigger than any of us had imagined. And it isn’t the kind of work that generates a lot of glory – because it’s essentially invisible. The audience just accepts the fact that the dog is white. Nobody thinks, ‘Wow, that’s impressive – how did they ever do that?’ Yet, it was a huge, huge undertaking.”

In a handful of cases, the spot removals were so difficult, the effects team began to think it would be easier and more effective to replace the live dog – or at least a portion of it, such as its head – with a computer animated model. “Rather than beat our heads against a wall, trying to remove the spots in those situations,” Rygiel commented, “we thought, ‘Why not just replace the live dog with a CG dog?’ We considered it seriously after we started getting plates back from production that had these really black dogs in them.”

The idea of integrating a computer generated puppy into the live-action was not entirely novel. Industrial Light & Magic had created a handful of shots for the first feature that had CG puppies as background elements. In a similar vein, Lima had intended, from the start, to use CG dogs for stunt sequences in *102 Dalmatians*. “Any time there was something we couldn’t do with a real puppy,” said Lima, “I assumed we would do it with CGI. I knew we’d have to do that for the climax of the film, for example, because we were going to be dealing with dangerous sets, as well as actions and stunts that I knew the trainers wouldn’t allow us to do with a real dog.”

The new strategy to replace the most seriously black-spotted live dogs with a digital Oddball would mean going well beyond these long-distance views and quick, action-oriented cuts. The effects crew would be dealing with extreme closeups of the CG Oddball, as well as shots in which the CG puppy was in the same frame as the live pups – inviting potentially unflattering comparisons between the real thing and the digital simulation. Not surprisingly, the idea was met with some trepidation, initially. “Everybody was scared,” commented Dan DeLeeuw. “The director didn’t have a problem with CG itself – but he didn’t think we could get that close to it and still have people believe it.”

As filming continued in England, the stateside Secret Lab team entered into research and development for the CG Oddball, starting with a study of the anatomy and behaviors of Dalmatian puppies. “We had dog trainers bring out some dogs we could look at and videotape,” said DeLeeuw. “We wanted to see how they moved, get an idea of the groom of the hair, and study some basic puppy actions for the animation. We also took reference photographs to study how the hair tapers into the belly, how it curls in the chest, that sort of thing.”

Those photographs served as the basis of a life-size maquette, sculpted by Jim McPherson, which was digitized to provide DeLeeuw and his crew with a jumping-off point for the CG model. Work on that model was well underway when DeLeeuw left to join the production at Shepperton – where he was met with an unhappy surprise. “As soon as I got there,” DeLeeuw stated, “I saw that we had a problem. The dogs they had on the set were very different from the ones we had used for our reference photos and the maquette. The American dogs had a somewhat different build – a bit heavier and a little broader in the chest – whereas the English dogs were smaller. The dog they were using for Oddball was especially small, because she was supposed to be the runt – a little more dainty and feminine. It was clear that our dog model was radically different from this one, and I thought, ‘Uh-oh, we’re in trouble.’ I grabbed my camera and started taking reference photos of the

on-set dog, then sent those photos back to The Secret Lab immediately so they could rework the CG model to match them.”

Fortunately, a tool in Maya enabled the modelers to revise the existing model rather than rebuild it from scratch. “It’s not completely analogous to working in clay,” explained DeLeeuw, “but this tool enables you to push things in and pull things out. It allows you to attach polygonal meshes as deform-ers to patches – so instead of pulling all the points that are on the actual patches, we could pull one point on a polygonal mesh, and that would pull many points on the patch. It was a quick way to get gross changes.”

Since no two on-set dogs looked exactly alike, the modelers attempted to build a CG model that was an amalgam of the five dozen live Oddballs. “We had to make sure that she matched the overall look,” said DeLeeuw. “She had to look like all the other Oddballs, but be cute in and of herself. With the multitude of Oddballs they had on set, some were naturally cuter than others. We had to make sure our dog was one of the cuter ones, so that the audience would want to look at her.”

In addition to modeling the animal’s exterior, DeLeeuw’s team modeled the underlying skeleton and muscle structure, gleaned from veterinary textbooks and an x-ray procured from a local animal hospital. “One of our people called around to vets, trying to find x-rays of puppies,” said DeLeeuw. “He lucked out, finding a veterinary hospital where an eight- to ten-week-old Dalmatian puppy had been x-rayed because she’d swallowed a bolt. You could actually see this little bolt sitting in her belly in the x-ray. From that and other reference, we began to construct our puppy skeleton. Ardie Johnson, one of our modelers, then went in and laid the muscle groups onto the skeleton. By doing that, when we sculpted the skin over the top, everything would move correctly. It was never meant to be an actual animation skeleton – we just modeled it to get an idea of what the real bone and muscle structures should be underneath our animation model. The more accurately we modeled those things, the more realistic our dog movements would be.”

Since the CG Oddball would fill the frame in a few shots, DeLeeuw, digital supervisor Wallace Colvard and the entire modeling team put enormous effort into the detailing of the model’s face. “There had to be a lot of detail in the eyes, the mouth and the teeth,” DeLeeuw commented, “in the way the hair blended into the eye, the black around the eye, the eyelashes and the eyeball itself – the corneal bulge, the clear portion, the highlights that went across it, the iris, the pupil, the whites of the eye, the wetness. We had a shader to create highlights



More than five dozen puppies played Oddball in the film, and some 250 shots required digital spot removal. The complexity of the assignment varied considerably from shot to shot depending on the number and placement of spots on each dog.

and reflections in the eye. We also had little pieces of geometry and a shader for the meniscus – the bit of water that pools up in the corner of the eye. There was as much detail in a single eye as there was in all the other parts of the model combined.” Such minute detailing contributed to the model’s twelve-hour-per-frame render times.

Once completed, the CG model geometry was sent to animation supervisor Matthew O’Callaghan and an inverse kinematics team for the building of animation rigs. One of DeLeeuw’s mandates was that the rigs be built with anatomical correctness in mind. “Animators like as much flexibility as they can get,” DeLeeuw commented, “but sometimes a too-flexible animation rig results in movements that aren’t entirely realistic. I wanted the animation rigs built so that the animators would not be able to put the model into a bad, unrealistic pose.” The modeled puppy skeleton also helped to ensure verisimilitude in the animation. “That gave the IK guys a reference in building the animation rig. All the pivot points and joints in the animation rigs matched up to the pivot points and joints in a real dog skeleton.”

In fact, The Secret Lab’s in-house tools allowed for the creation of an animation rig that was, in essence, a point-by-point simulation of the real dog skeleton and musculature. “The skin and muscle system we use at The Secret Lab is much more than what you typically get in out-of-the-box packages,” DeLeeuw explained. “In many packaged versions, the IK rig is bound directly to the skin. But our rigs basically had bones, muscles attached to the bones, and skin attached to the muscles. So as the muscles moved, contracted and bulged, the skin moved in relationship to all of that underlying muscle movement. The animator would animate the bones; and once that was all set up, the subsequent animation of the muscles and skin was fairly automatic. We’d do a little bit of cleaning up and tweaking to make sure that the muscles weren’t bulging too much or popping out of the dog; but for the most part the muscles and skin self-animated, based on the animation of the bones underneath.”

For the puppy's hair, The Secret Lab modified grooming tools first developed for the lemur characters in *Dinosaur*. In addition, the team expanded upon the capabilities of a fur shader developed at Dream Quest Images – a one-time separate effects entity since folded into The Secret Lab – for *Mighty Joe Young*. “This was a great example of the two companies coming together and combining tools to create new technology,” DeLeeuw observed. The puppy hair pipeline started with guide hairs being positioned along the surface of the model. “Instead of trying to deal with the two or three million hairs that would actually be on a dog, we used a few hundred hairs that could be controlled with the grooming tool to create the curl of hair on the chest for example, or slight imperfections in the facial hair. From there, the software filled in the gaps between the guide hairs.” That hair file was then passed off to RenderMan. “When we were dealing with hair in RenderMan, it was not actually a 3D cylinder, like real hair would be. It was flat like Christmas ribbon – a cheat to make it render quite quickly. At this stage, the trick was to make sure that flat ribbon hair wound up looking round – which is what the shader did. We wrote a reflectance model that made it appear like a rounded surface catching light.” Shadow maps ensured that each hair created the appropriate shadow on the one below or beside it. “Without that kind of shadowing, we’d get an odd bounce light coming off the hair, an illumination that shouldn’t have been there.”

Once DeLeeuw, Rygiel and effects producer Liz Ralston were confident that the CG Oddball both looked and moved like the real thing, they inserted a test shot among a slew of spot removal dailies, and ran the reel for Kevin Lima. “This test shot was the CG dog in full frame, sitting there, then getting up and walking out, right past camera,” DeLeeuw stated. “We weren’t sure at first whether we should tell Kevin it was there, or if we should just slip it in with all of these other live shots, without telling him. Because of Kevin’s background in animation, he was always very perceptive about the animation and lighting tests we showed him. We finally decided not to tell him. So he came and looked through all of these shots – and he didn’t say anything. Then he looked at them again, and he still didn’t say anything. Finally, Liz Ralston said, ‘Did you see anything unusual about any of those shots?’ Kevin said, ‘No.’ So he watched them again – and he still didn’t pick up on it. Finally, we told him that one of the dogs was a CG dog – and he was blown away.”

“When they told me that they’d replaced one of the puppies with a CGI puppy, I was in shock,” Lima admitted. “They’d completely fooled me – even on a fairly close shot of the dog’s face. When I looked



Spot removal entailed an initial procedural step that was successful in extracting many spots seen straight on. Most of the spots, however, required tedious hand work, each being painted out and replaced with a cloned patch of like-textured fur.

at it more closely, I spotted the CGI because the dog blinked, and that action had a bit of an animation feel to it. But I was completely amazed. From that point on, I opened the gate a little bit to solving some other problems with CG dogs.”

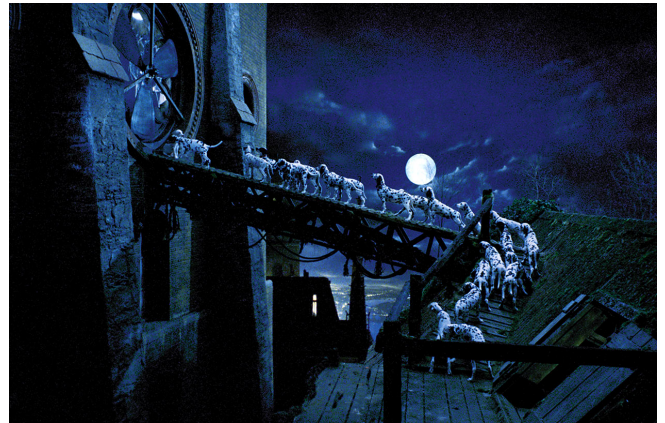
Lima’s positive reaction to the test led to the inclusion of more CG shots, such as one in which Oddball is sitting in front of a television set, wearing a spotted sweater. The head of the live puppy used for the scene featured not just black spots but an entire black mask – a difficult spot removal due to the size of the black mass. To get around the problem, DeLeeuw’s team replaced the head with a CG version. In some respects, this shot was even more difficult than the test, since the camera would remain on the dog for a long time. “The test shot was close on the CG dog,” said DeLeeuw, “but in that one, Oddball got up and left frame fairly quickly. The camera was going to stay on this one much longer. So we went in and worked on the eyes a bit more. We also added in a little nervous shake of the head that all puppies have. We showed that to the director and he was very impressed. I think that shot really convinced him that we could do head closeups – because we started to get more and

A more stunt-oriented CG puppy shot featured Oddball tumbling out of an office window, into a gutter and onto a ledge. The challenges of the shot revolved around making the puppy’s fall and landing look real, yet nonviolent, so as not to arouse the concern of young children. Another challenge was to make the dog’s bounce onto a ledge that actually stood a few inches above the gutter in which she first lands look plausible – even though it was a feat that, in terms of real physics, was not possible. “In a lot of the early animation tests,” noted DeLeeuw, “she looked almost as if she was elastic because she’d come down into the gutter and then bounce on top of the ledge. We couldn’t make her bounce like a ball and still look believable – unless she hit really

hard. But when we animated her to land hard, it looked like she’d be hurt. We wound up having to find a line between the too-soft landing and the too-hard landing. We had a similar problem with a later shot, when she chases after a train, jumps to catch it, and falls off, dropping nearly four feet. In reality, a puppy couldn’t take a fall like that, then jump up and run – but that’s what Oddball does. She falls, rolls, and keeps running. We were hopeful that no one would think twice about that. We just have to assume that Oddball had a lot of martial arts training!”

The digital Oddball was a tremendously rewarding effects assignment, as it gave The Secret Lab an opportunity to strut its 3D character animation stuff. “To this day,” Jim Rygiel observed, as postproduction on *102 Dalmatians* came to a close, “we roll through our shots, and I have to remind myself that there’s a CG dog in there. She sits there, then stands up and walks right past camera – and no one in the audience will ever be the wiser.”

For Kevin Lima, the character was a revelation in terms of the potential applications of computer animation to live-action features. “The line between live-action and animation is becoming more



Any scene with more than five or six dogs – the maximum number that could be managed on set – required multiple passes and traveling split-screens to achieve the desired effect more shots.”

and more blurred,” Lima reflected. “Some people talk about that with fear; but to me, it means that live-action will be able to go to worlds that, previously, we could only go to in animation. And that is incredibly exciting.”

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THE WHOS AND WHYS OF HOW THE GRINCH STOLE CHRISTMAS

ARTICLE BY

MARK COTTA VAZ

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A snowflake wafts through space and the curious camera eye zooms in. Like that poetic eternity in a grain of sand, its interior—a catacomb of jagged ice blocks and glittering ice crystals—opens onto a God’s-eye-view of sunlit skies, swirling curlicue clouds and soaring snow-covered peaks. The camera swoops down to a village bedecked in Christmas finery, a cozy place of cheer amidst an icy wonderland. But above the village looms a strangely lopsided mountain with a foreboding cave, a dark hole of gloom.

Thus begins Dr. Seuss’ *How the Grinch Stole Christmas*, a Universal Pictures holiday release directed by Ron Howard under the banner of his Imagine Entertainment production company. The only other adaptation of the beloved 1957 illustrated children’s story, by the late Theodor ‘Dr. Seuss’ Geisel, had been the Chuck Jones animated TV version—a perennial favorite for more than thirty years—which was faithful to the fable of the cranky, cave-dwelling Grinch who steals the presents and trappings of the town’s Yuletide celebration only to discover that the Whos of Whoville still greet Christmas morning with their holiday spirit intact.

Both the original story and the animated special had kept the Grinch’s hatred of Christmas and those Whos down in Whoville veiled in mystery, merely noting as a possible motive his rumored two-sizes-too-small heart. But the big-screen version would reveal the why of it all, at the same time conjuring up an entire world, a population of Whos, plus one Grinch—designs all inspired by Seuss’ quirky, beguiling imagery.



Dr. Seuss’ forty-plus-year-old children’s fable, *How the Grinch Stole Christmas*, made the leap from illustrated page to silver screen with a live-action feature directed by Ron Howard under the banner of his Imagine Entertainment production company. The Universal Pictures release remained faithful to both the original storybook tale and a subsequent, perennially popular, animated television adaptation by Chuck Jones, but expanded the narrative to feature-film length with a backstory that revealed how the Grinch came to despise the Christmas-loving Whos down in Whoville.

For everyone involved, the production would prove to be one of the most ambitious in memory. Production designer Michael Corenblith—a Ron Howard veteran with credits on *Ransom* and *Apollo 13*—erected lavish sets, ranging from the Grinch’s lair atop Mount Crumpit to downtown Whoville, that filled Universal Studios’ biggest soundstages. Special effects coordinator Allen Hall—an Oscar nominee for his work on Howard’s *Backdraft*—and his company, Special Effects Unlimited, fielded an unusually large crew of fifty-eight technicians to handle the production’s ambitious on-set effects. Makeup guru Rick Baker and his Cinovation Studios not only transformed actor Jim Carrey into the title character—a huge undertaking in itself—but ground out ninety makeups per day for the large cast of Whos, making Grinch the biggest makeup show ever, surpassing even the benchmark *Planet of the Apes* and its sequels.

Equally daunting was the visual effects effort, led by visual effects supervisor Kevin Mack and production visual effects producer Kurt Williams. Grinch would be the biggest show taken on by lead house Digital Domain since the company’s formation in 1993; and, as big as the project was at the beginning of preproduction, the slate of effects shots would double by the time the film reached completion, requiring the involvement of other vendors to handle a few add-ons at the tail end.

Because of such tremendous makeup and effects demands, as well as the potential logistical nightmare of filming in a wintry location, it had been an easy call to shoot most of the film—both interiors and exteriors—in the controllable environment of enclosed soundstages and studio backlot locales. But the impetus to prevent the production from looking ‘stagebound’ was accelerated in the aftermath of a premonition that Imagine producer Brian Grazer shared with Ron Howard early in the preproduction. “Ron has a tremendous respect for Brian’s intuition,” commented Michael Corenblith, “and so he listened when Brian told him he’d had a bad dream about Grinch. In Brian’s dream, he was at a screening of the movie, and it looked stagebound and small. So, rather than thinking in terms of a 400- by-300-foot stage, we calibrated everybody’s meter to think in terms of a fully realized world. It put a huge burden on the crew at Digital Domain, who would have to extend that stagebound world through visual effects, but it seemed like the best way to meet the bad dream head-on.”

“Brian’s bad dream reinforced what all of us were thinking,” Ron Howard affirmed. “The Grinch had to look right, the Whos had to have the right feel, Whoville had to look right—and, for God’s sake, it had to feel like a complete environment, not a stage set.” To this end, the filmmakers decided to surround the exterior stage sets on all sides with bluescreen, providing a 360-degree matte area into which Digital Domain could composite its 3D CG world. In addition, entire sequences would use completely CG environments, with many shots created minus any photographic elements whatsoever.

For Howard, who had helmed such effects-filled productions as *Willow* and *Apollo 13*, the film’s virtual set extensions would prove to be a revelatory delving into cutting-edge digital filmmaking. “This was the heaviest effects show I’d done since *Willow*,” Howard observed, “and the rules had changed so much. The shackles were off—which was exciting, extraordinary and liberating. Frankly, when I was working on *Willow* it was all good fun, but I felt limited by what I could do with staging and camera work. I was intent on not falling into any of those traps on Grinch.”

One effects trap Howard and cinematographer Don Peterman strove to avoid was a dependency on locked-off shots. "Grinch had drive and energy," said Howard, "so I wanted the audience to participate through the camera, not just sit back and watch. This was not the traditional situation of closeups, then cut to the wide, locked-off matte shot. We created rules for ourselves in terms of photographic style. A trick I'd learned on *Apollo 13* was to simulate weightlessness by using a circular camera rig mounted on dollies or sideways, so the camera was angled fifty or sixty degrees and allowed to drift. I applied the same idea of a moving, floating camera to most of the scenes in *Grinch*. It was subtle, but it helped to create the illusion of a world where an individual's sense of balance is different than ours. I wanted motion and fluidity, with the frame constantly shifting, revealing the edges of the town or the peak of Mount Crumpit. I didn't compromise on camera movement—which made it difficult for the effects people."

In addition to utilizing a constantly moving camera, Howard, Peterman and producer Todd Hollowell—who would also serve as second unit director—intended to shoot much of the movie with wide-angle lenses to make the environment feel as big as possible. Since both the camera movement and the wide-angle lenses meant that the virtual environments would be on screen with much of the live-action, the filmmakers decided that Digital Domain should be brought on board the production as soon as possible. "We wanted to be able to move the camera the way you would on a big location," stated Kurt Williams. "To do that, we had to know what the views on Mount Crumpit were going to be, for example, and what Whoville would look like if you could shoot it from a helicopter. We needed to have Digital Domain in on the development process so they could grow with the movie—as opposed to us shooting, then bringing in an effects house later. We had to build our virtual world concurrent with that of the first unit."

Digital Domain having previously enjoyed a successful collaboration with Ron Howard on *Apollo 13*, first saw the *Grinch* script in July 1999 and was officially on the project by the following month. Kevin Mack and a Digital Domain crew were on hand when principal photography began that September, and maintained a presence during every day of the shoot. "It was such an advantage," stated Mack, "to be involved and encouraged to contribute to the show creatively, from the beginning, through the entire production cycle, to final color timing of the last reel."

While creating an organic, complex and believable world for the film—either practically or through the use of effects—the filmmakers were also intent on making all things within that world 'Seussian.' "From the beginning," Williams said, "we set out to build a world inspired by Dr. Seuss. It's not our world, but a world in and of itself." The phantasmagorical visual style that Seuss fashioned over five decades of writing and illustrating children's stories poured into the live-action *Grinch* feature. But adapting the author's topsy-turvy two-dimensional line art to live-action imagery was easier said than done. "Our biggest challenge," remarked Mack, "was translating Dr. Seuss' intrinsically two-dimensional style of drawing into a realistic three-dimensional world, while maintaining the Seussian look."

It was up to Michael Corenblith to establish the ground rules for that Seussian look. Working with art department principals, including supervising art director Dan Webster and construction coordinator Terry Scott, Corenblith started with the look of Whoville. "What I pitched to Ron," noted Corenblith, "was that Whoville, in essence, was a medieval village in a pristine alpine setting which,

in its atmosphere of light, snow and trees, spoke of Christmas. But I wanted to avoid the look of a Santa's Village plopped down from the sky, where everything seems fabricated from the same elements. Conceptually, Whoville had to feel not only as if it was there, but as if it had been there. I wanted a sense of different time periods and a continuity between buildings, each of which had its own story and history."

Taking a cue from the script's revelation that the Grinch was raised by a pair of 'old biddies'—characters the production designer felt could have been cast from the mold of Tennessee Williams' dissolute Southern women—Corenblith designed the Grinch's childhood home as a building transplanted from New Orleans' French Quarter. Town Hall was designed with the ionic columns and iconic dome of a civic building, but was imbued with Seussian whimsy, with rounded shapes and animal statues flanking the steps. Farfingles Department Store, another key building built in the round, was inspired by the elegant art nouveau designs of Parisian shopping centers dating back to the early twentieth century.



On the downtown Whoville set, Ron Howard discusses a scene with actor Jim Carrey, unrecognizable as the Grinch. Enduring a daily two-hour-long application of Seussian prosthetics, contact lenses, dentures and fur suit, Carrey was transformed into the title character by makeup artist Rick Baker and his Cinovation Studios team. Concerns that the extensive makeup might impede Carrey's performance or, perhaps worse, negate the point of hiring a \$20 million star led to serious debate at the production level and by studio executives—but in the end, Baker's preference for a head-to-toe makeup won out.

In making the jump from concept to working plans, Corenblith decided that the best way to explore Seuss' aesthetic was to work from sculptures and scale models, instead of standard blueprints. "No one had really tried to realize what these Seussian forms would look like in three dimensions," Corenblith explained. "I wanted to make these design decisions based on a hands-on exploration of models—so we did tons of things in clay, then photographed and scanned the models and worked on them in Photoshop." Well into the process of working with the scale Whoville models, Corenblith still felt a certain design element was missing. "I had the town square models laid out—and then, as an unconscious act, I took a piece of Bristol board and cut it into a spiral bridge across one of the main roads. And that's when a big lightbulb went off. I realized that Seuss' drawings had a lot of dynamic diagonals guiding the reader's eye on the page." That signature illustrating style had been apparent as early as Seuss' second book, *The 500 Hats of Bartholomew Cubbins*. "In that book, he had drawn bell towers with spiraled stairs and no handrails. Later on, these Seussian stairs without handrails started appearing everywhere—big loops and forms that were perfect compositional tools for making strong diagonals from page to page and text to text. As soon as I put down that first little scrap of cardboard bridge, I knew I had the key. I became much emboldened in the use of these stairs, designing flying bridges with no handrails and big cantilevered spans rising fifty feet off the stage floor." Foam-covered steel tubing—configured to look like curving, looping roller coaster tracks—made up Whoville's Seussian bridges and spans.

Construction coordinator Terry Scott would come to define 'Seussian' as meaning, simply, 'nothing was straight'—making for the worst possible scenario, in terms of construction. Scott and his 250-person crew, which included mold makers, plasterers and sculptors, would spend four months at Stage 12—Universal's biggest—working in plaster and styrofoam to construct the twelve major building



In addition to the Grinch makeup, the Cinovation team designed and produced the whimsical look for an entire community of Who characters, making Grinch the biggest makeup assignment ever. Baker touches up a member of the Whoville band.



The production relied heavily on Digital Domain to fabricate a stylized, yet photorealistic world for the film. Under the direction of visual effects supervisor Kevin Mack, the company realized more than three hundred shots—many of them entirely computer generated. Mack reviews a shot with visual effects producer Julian Levi.

exteriors comprising downtown Who ville. On other stages, the crew built city interiors out of lath and plaster.

To cover the various sets with snow, Allen Hall and his special effects crew secured customized twenty-six-foot-diameter machines—designed to spray a shaving cream type of foam onto a large area—into the permanents of the Whoville stage. For additional snow, the crew also placed a few extra wild units close to camera. Due to the quantity of snow required, standard snow machines would have been inadequate. “We’d have been refilling them every ten minutes,” said Hall. “So we adapted the technology to special oscillating machines that provided a lot of coverage very quickly. All of the units were tied into a computer, so we could program how many machines would run, as well as adjust the foam from heavy to medium. Since the whole system was wired together, one guy on the floor could literally push a button to snow the entire stage.”

Production designated Stage 27 for the Grinch’s cave exterior, which towered eighty feet from stage floor to permanents. After first unit had shot the cave, the set was demolished; and in its place Crumpit’s peak was built, rising from seventeen feet below the stage floor to a height of thirty-four feet. In addition, Corenblith designed a massive cave interior, built on the legendary *Phantom of the Opera* stage. “The cave needed to have a certain volume and feel to it,” remarked Corenblith, “because Jim Carrey was going to be Jim Carrey—very kinetic. I wanted to give him opportunities to move from place to place without being confined to ladders or stairs. I conceived a geological space that was a combination of a cathedral and the Guggenheim Museum stood on its head. The whole set was built with a big spiral ramp that enabled Jim to move up and down, with chambers off various levels in this huge space. But, ultimately, the cave was about being alone. From the start, I had a sense of the space and desolation in the scene from *Citizen Kane* where Kane sits in his vast room in Xanadu.”

In a series of meetings held before production, Corenblith, Kurt Williams and Kevin Mack had to determine which areas of Whoville to build as set and where Digital Domain’s CG Who ville and terrain would take over. Working under both a tight deadline and a tight budget, the effects company had to come up with an efficient methodology for computer generating the vast, photorealistic environments required by the production—from the buildings pushing out the borders of the main Who ville set, to the outlying hills of Who Valley, to the surrounding icy peaks and mountain ranges, dubbed ‘the badlands’ by the effects squad.

A key peak in the topography was the Grinch’s mountaintop abode—Crumpit. The Digital Domain crew started by configuring a pre visualization model of Crumpit and the surrounding mountains, the highest of which was Who Mountain, conceived as twice the elevation of Mount Everest. In a valley near the top of this mighty mountain was the town of Whoville, with Mount Crumpit rising from the valley to loom several thousand feet above. “I began with a virtual sphere of earth-like proportions,” recounted CG supervisor Matthew Butler, “and bumped up a mountainous region procedurally in Houdini. Then I raised the virtual camera up to what Kevin Mack felt looked right for Who Mountain, which turned out to be 60,000 feet. It was a purely aesthetic choice on Kevin’s part. He wanted it to feel as if it was on top of the world.”

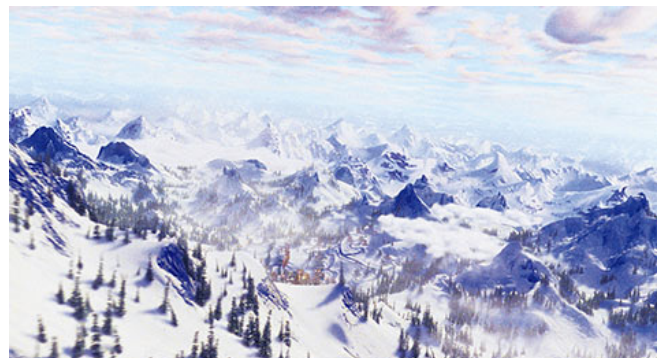
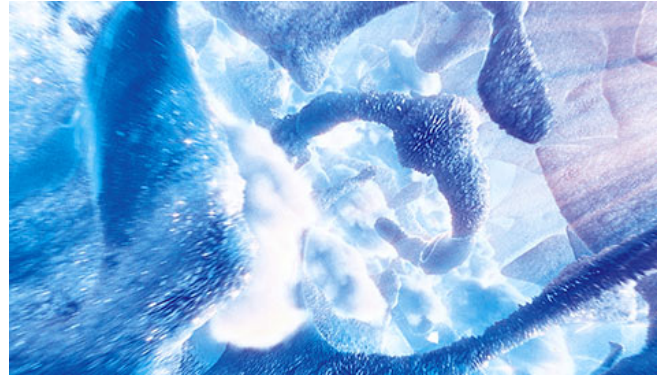
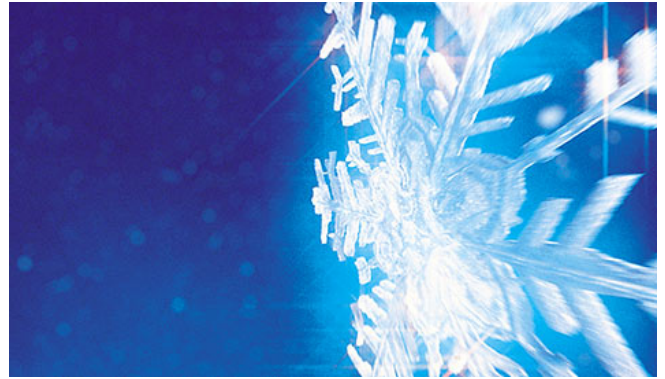
Besides providing a virtual world complete with continuous topography and identifiable landmarks, the model determined the boundaries between 3D geometry and 2D matte paintings.

“We needed a twenty-mile radius of 3D geometry to maintain 3D perspective for the large virtual camera moves,” Butler said. “Beyond the twenty-mile radius we could get away with hybrid 2D/3D solutions.”

“This show completely dissolved the boundaries between 2D, 3D and matte painting,” Kevin Mack remarked. The pan-and-tile capabilities of Digital Domain’s in-house Nuke compositing system went a long way toward blurring those boundaries. “First, we created our world with full 3D complexity. We then rendered a large field-of-view 2D image of our 3D world, which gave us the freedom to use any 2D operations—such as painting, warping, cloning or compositing—on that 3D world. Using the simple and fast pan-and-tile operator in Nuke, we would then recalculate the camera motion with all of the 3D transformations and perspective.” Since the method avoided the need for time-intensive multi-frame 3D renders, it had the advantage of saving thousands of hours, as well as terabytes of disk space. “In addition, we could adjust and art-direct, without the need for costly re-renders, right up to the last minute. It also made it possible to complete 3D renders before we had a final 3D camera track.”

The ability to art-direct was important, given that the environment was always considered key to telling the story. “Kevin Mack wanted the sky to be a character throughout the movie,” Kurt Williams stated, “in that it would help convey the emotions of a scene. When we’re in Whoville, it is overcast but still bright and cheery. When the Grinch steals Christmas, the sky is a deep, dark purple.”

The skies were comprised of many painted elements, including color gradations, stratus layers, puffy cumulus clouds and foreground wispy atmospherics. “The look of the skies and the clouds presented a great opportunity for us to contribute creatively,” said Mack, “since Seuss’ illustrations were so graphic and two-dimensional.” Martha Snow Mack, who oversaw Digital Domain’s paint department, came up with appropriately Seussian curlicue cloud shapes. “When we first started,” digital paint lead Shannan Burkley recalled, “we didn’t know how strange to make the clouds. But Kevin pushed us to make the skies surreal and Seussian, yet three-dimensional and realistic.”



Digital Domain rendered the 2D environments, though stylized, with all the realistic properties of a real location, producing 360-degree paintings of the sky and distant mountains for each sequence. Compositors selectively animated the painted cloud layers with 3D perspective in the compositing stage, and comped clouds in between layers of mountain ranges to create a 3D effect. "Instead of being locked into a predetermined 3D-rendered sky element," observed compositing supervisor Bryan Grill, "we could adjust and readjust individual shots and build our sequence continuity over time, without having to re-render complex 3D elements. The biggest timesaver was establishing that pan-and-tile pipeline. Not only did the pipeline enable us to get through all the shots, it allowed Kevin and Martha to art-direct each shot and the sequences as a whole, thereby keeping the creative door open."

In addition to providing all the background mountains and skies, Digital Domain extended the soundstage sets of Who ville through its virtual construct. "Michael Corenblith and his team designed and built this beautiful set of the center of Who ville that captured the Seuss style and yet felt like a real place," Mack observed. "Once we had determined what Michael's team would build and they had arrived at a style for the architecture, set extension supervisor Vernon Wilbert and I began designing the overall layout of the town, its roads and suburbs, and relating them to Michael's set designs. Because Michael's team was so busy working on the sets, we had to design all the CG buildings, as well as build them. I had Vernon and his team take an 'evolutionary' and modular approach. They would create a lot of quick, simple models—some of them whole buildings, some just shapes and pieces like twisting columns and arching stairways. We continued to develop those that embodied the style Michael's buildings had achieved and abandoned the ones that didn't. Eventually, Vernon and his team had created a whole town of buildings that all looked as if they belonged."

Corenblith provided the Digital Domain crew with concept art and scale models of the set buildings, along with insights on all things Seussian. But while the virtual world would enable the set extension artists to expand on the fantastic, whimsical nature of the Seussian structures, those CG buildings had to tie in with the practical ones. "We had to make sure our buildings could function in the same frame with their buildings," Wilbert said. "Our buildings had to look as if people could really go in and out of them, and that they could be built in the real world if needed. The level of reality in the sets had to continue in our CG extensions."

The Whoville construction team at Digital Domain—including Andy Waisler, Howie Muzika, Gaku Tada and Kevin Jackson—began thinking in terms of a real world, and gave their Who buildings a personality and backstory, just as Corenblith had done. "Because the set would be growing three to four times its size with the extensions," noted Wilbert, "we had to start building districts. Each artist had his or her own section of town. In the west side we put townhomes and condominiums; south central was the shopping and theater district; and the north side had utilitarian stuff like gas stations and motels. Then we had some suburbs perched on the sides of hills." Digital Domain used

A magical journey through a snowflake opens the movie and culminates in a reveal of Whoville and its environs. Photo reference of glacial ice caves and geological crystal structures provided visual inspiration for the snowflake environment, designed by Kevin Mack. Isosurfaces were used to create organic forms within the snowflake, while custom shaders provided the look of frost and ice. As the camera continued to move in on the computer generated Seussian world, volumetric digital clouds smoothed the transition from crystalline snowflake interior to snow-covered peaks—including Mount Crumpit, home to the Grinch—and then to a wide shot of Whoville nestled in an alpine setting.

Maya for modeling the virtual sets, and Mental Ray for rendering. “We decided to model in NURBS instead of polygons because the buildings designed by Michael’s team were very fluid structures. They looked as if they had been built from NURBS, which allow you to see a final smooth surface as you work on it.”

Taking cues from the soundstage sets, the virtual set extension crew designed and built a myriad of structures to create the extensive CG Whoville, each evaluated by Corenblith, Dan Webster and the rest of the production art department in the equivalent of an architectural jury. “The production art department people, who’d been dealing with building design issues for the previous six months, were able to impart what they’d collectively learned to the Digital Domain guys straight-away,” noted Corenblith. “Because of this process, the marriage of the digital buildings with the sets was seamless.”

Vital to the 3D camera moves required to integrate the CG set extensions were on-set notes, measurements, photographs and surveys recorded by 3D tracking supervisor Robert Frick. Digital Domain eventually 3D-tracked more than three hundred shots to match the virtual camera to the ever-moving on-set camera. “Due to the extremely wide-angle lenses and the very large crane moves employed throughout the film,” stated Mack, “Robert and his team faced the greatest tracking challenge ever.” Taking advantage of advances in Digital Domain’s proprietary tracking tools, the team was able to meet this monumental tracking challenge with confidence. “No motion control or encoding of any kind were used on the film. For the first time, we were able to take on a project of this scope without the need to rely on those techniques, which can be costly and cumbersome to production.”

Once modeling and positioning of the CG environments were accomplished and the virtual camera movements established, the shader development team, led by Johnny Gibson, completed the computer generated elements. Realizing that the scope of the work was going to be vast, Gibson set out to define terrain shaders that, to a certain extent, could self-define appropriate behaviors. For example, a snow shader could be biased to the steepness of the topography, causing snow to be rendered only on the flat surfaces, leaving the sheer rocky cliffs bare. The shader team also devised an efficient way of creating photo realistic trees for the virtual landscape, constructing a library of fourteen different tree models, which could be scaled and oriented for variation. Though the models consisted of minimal geometric complexity, the shader could create complex detail through texture mapping. “These trees had to hold up in moving 3D shots at proximity,” commented Kevin Mack, “and yet still be simple enough to allow for up to 40,000 of them to be on screen at once.” Even with the efficient methodology, the Digital Domain team had to render the trees in multiple passes, with the cumulative complexity of entire forests creating massive memory requirements.

A computer monitor on the live-action sets made it possible for the director to see exactly what CG views would be materializing out of the bluescreen. The view up to Mount Crumpit, for example, could be displayed from any specific vantage point in Whoville. “We would essentially do a rough composite on the set by taking a feed from production’s video tap into the computer,” recalled Digital Domain visual effects producer Julian Levi. “We would capture a frame from the video tap, do a single-frame track, and composite in the terrain or Crumpit or whatever building extensions we had.” Through these displays, Ron Howard quickly understood what the world would look like beyond the practical sets. “Once Ron knew where Mount Crumpit was from Whoville,” said Kevin

Mack, “and where Whoville was from up on Mount Crumpit, he just went on shooting the movie as if they were there.”

Giving over so much of the movie’s settings to visual effects had required an extraordinary leap of faith on the part of Ron Howard and the producers. “Ron and Todd really did not have any choice but to have faith that we could pull it off,” admitted Mack. “I remember one late night on the set there was a problem with a practical shot, and Todd asked me if we could ‘fix it in post.’ I told him it was no problem. Then Todd looked at me very seriously, and said, ‘You know, I sure hope you know what you’re doing, because if you turn out to be full of shit, we are completely screwed.’ It was a great feeling when we finally got to show them our stuff!”

While the production design staff and Digital Domain artists created the story’s fantastic settings, Rick Baker and his Cinovation Studios team took on the task of populating Whoville with its Who citizens and Mount Crumpit with its lone inhabitant—the Grinch. Production principals agreed that Jim Carrey, famed for the kabuki-like precision with which he could contort his body and face, was an inspired choice to play the hairy misanthrope. Of all the fantastic characters created by Dr. Seuss, the Grinch, with his Scrooge-like disdain for Christmas cheer, was one of the most memorable—and possibly the most personal for the author himself. In the story, the Grinch reveals that he has put up with Who Christmases for fifty-three years—exactly Geisel’s age when his fable was published. And Geisel’s car license plate reportedly read ‘GRINCH.’

Baker’s design team began by working off a Carrey lifecast to develop the Grinch looks. Baker was seeking unique designs, and so he had each member of that team work at separate locations to avoid any possible derivations. Howard and Grazer ultimately embraced Baker’s own concept—a look less Seussian and more practical, with the Grinch nose aligned with Carrey’s so the actor could comfortably breathe through his own nostrils. But Baker himself decided his design could be improved upon by combining it with that of other in-house designers—notably, Eddie Yang, whose concept featured a bigger muzzle piece and a nose positioned more between the eyes.

Baker sculpted the revised concept based on his own lifecast and had himself videotaped in full Grinch makeup and Santa suit. When Grazer and Howard viewed the video, however, they were concerned as to whether Carrey could express himself in the makeup, and asked for fewer appliances. “I was convinced that Jim Carrey would be able to work the makeup like nobody else,” Baker insisted. He resolved to likewise convince the filmmakers that his Grinch makeup was not excessive.

Howard’s reservations regarding the makeup were not about wanting Carrey—a big star—to remain recognizable. Rather, the director’s concern had to do with the actor’s range of motion in such an appliance-heavy makeup. “All of us—Jim, Rick and I—wanted to transport audiences to an environment that had this amazing fantasy character,” said Howard, “so I was never afraid of Jim getting lost in the makeup. But lesser make up seemed to equal a wider range of motions. Getting to the right makeup was a long process. Rick began working with fewer makeup appliances, then drifted back to more. Other modifications were made. Finally, we did go back to more instead of less.”

During ten scheduled makeup tests on Carrey that followed, the actor did indeed ‘work the makeup.’ At one point, Baker scanned footage of Carrey in the Grinch makeup and digitally stretched his neck as a test. “When I showed that test to Ron,” Baker recounted, “he said, ‘You moved his eyebrows too much—no one is going to believe that!’ And I had to tell him that I hadn’t moved the eyebrows—that was all Jim!” Despite such proof of the makeup’s flexibility, Carrey remained uncomfortable beneath the multiple appliances. During a final test, the frustrated star announced that he did not want any prosthetics on his face and asked a crestfallen Baker to simply paint him green. But that same day, while on a break from the makeup chair, Carrey saw a photo of Baker in the full Grinch-and-Santa-suit concept—and fell in love with it. “Carrey saw this picture and said: ‘This is what the Grinch should look like, man! This is the Grinch! Why don’t we do this?’”

Baker completed a quick final test makeup for Carrey and a resculpt for the production. But just two days before shooting, one last monkey wrench was thrown into the machinery. “We got a call from an executive at Universal,” Baker recalled, “saying: ‘We’re paying Jim Carrey \$25 million for this picture, and where is he? It could be anybody in that suit! Let’s just paint him green.’” Baker did paint Carrey green—but only to demonstrate how lacking it was compared to the full-on prosthetics. “I felt strongly that it would be very disappointing to go to this movie and just see Jim Carrey painted green. The makeup not only made him the monster that he is, it allowed for sympathy when his heart finally grows.” The studio at last agreed and gave Baker’s preferred Grinch makeup the go-ahead.

With Baker dividing his time between *Nutty Professor II* and *Grinch*—shooting concurrently on the Universal lot—the day-to-day Grinch application work was handled by Kazuhiro Tsuji, who had joined Cinovation during *Men in Black*. Hailed by Rick Baker as ‘the next great makeup talent,’ Tsuji had begun working with Carrey during the makeup test phase. Since the daily transformation of the actor into the Grinch would be a grueling ordeal, much of Tsuji’s task centered on keeping up with the needs of the mercurial star.



The makeup and effects complexities of the picture mandated that Ron Howard shoot both interiors and exteriors in the controllable environment of soundstages and studio backlot settings. Production designer Michael Corenblith filled the biggest stages at Universal with massive sets representing Whoville and the Grinch’s lair atop Mount Crumpit. Among the sweeping design elements inspired by the original Seuss illustrations were bridges without hand rails and cantilevered spans extending over the village.

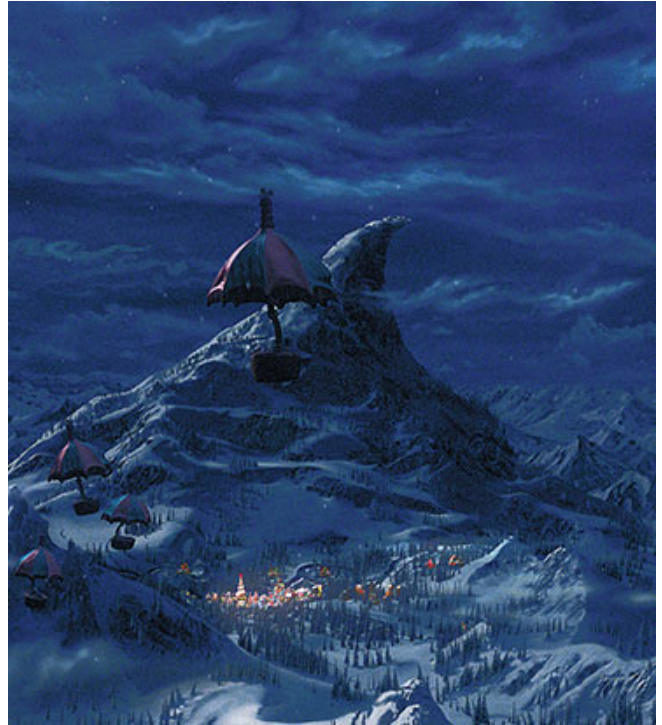


A staunch production-wide commitment to avoiding a stagebound look to the film, coupled with Ron Howard’s determination to employ constant camera moves and wide-angle lenses, required that Digital Domain extend and augment Corenblith’s physical sets—as large as they were—with expansive CG environments rendered in both 3D and 2D. Practical and digital elements blend seamlessly in a finishing Whoville composite.

Cinovation designed the Grinch makeup methodology with both efficiency and Carrey's comfort in mind, stocking a private makeup trailer at Universal with a week's worth of appliances that Tsuji prepainted with the base color—shaving an estimated hour off each makeup session. Also on hand were three versions of a fur suit, four sets of specially made contact lenses, and five sets of misshapen dentures. Typically, Carrey would arrive at the makeup chair between 5:30 and 6:00 a.m., and Tsuji would begin the daily ritual by flattening down his hair and covering his face with a skin-protecting salve. Three main prosthetic pieces were applied to make up the Grinch's face—the first a forehead appliance extending to the bridge of Carrey's nose and corners of his eyes and ears. The second was a piece for the back of the head, covering the ears and attaching to the forehead appliance. A final muzzle piece covered the cheekbones, but left the chin and neck exposed for a green paint job. The appliances were glued in place with Pros-Aide, a medical adhesive. "Some people use the 'wet technique,'" Tsuji noted, "which means that as they glue on a piece, they splash on the Pros-Aide and push down where it is wet. But since Jim did not want to sit in the chair for a long time, the best technique was to first put on the Pros-Aide and let it dry completely so it was like a sticker, then push down the appliance."



A wholly CG view of Mount Crumpit. Digital Domain built a previsualization model to define the topography of Who Valley and outlying mountain ranges.



In another all-digital shot, a flotilla of umbrellas delivers baskets of babies—including a newborn Grinch—to Whoville families.

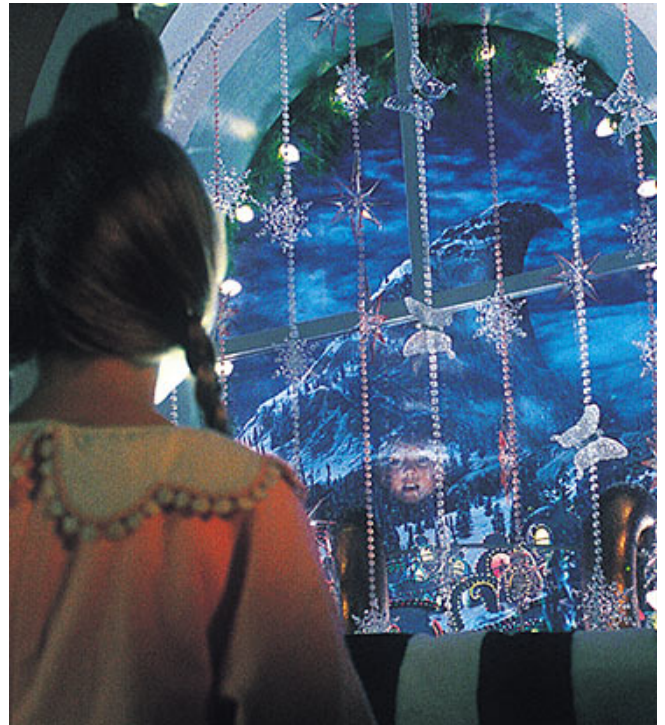


The backstory of the Grinch's neglected childhood sheds light on his hermit existence atop Mount Crumpit. Michael Corenblith constructed the cave entrance to the Grinch's mountaintop lair on stage, surrounding it with blue backing to accommodate CG set extensions.

After the blends on the main appliances were painted, Tsuji added an unruly wig. Lastly, the actor would get into the layered Grinch skin, beginning with a spandex suit, then a foam body shape suit, and finally another spandex suit of green hair—both synthetic and yak—which snapped into the wig piece. For scenes in which the Grinch is slumming as *Santa Claus*, the actor would wear only the exposed furry arm and leg pieces. When makeup application and suit-up went smoothly, with out extended breaks, the process took just slightly more than two hours to complete.

Adjusting to the Grinch get-up was not easy for Carrey. His face covered with prosthetics, his body encased in a furry suit and even his teeth covered with dentures, the actor felt imprisoned—especially in the first few weeks of shooting. “He panicked a few times because of claustrophobia,” Tsuji remarked. “One time, when he just couldn’t wait any longer, he ripped the makeup off and ran out from the set back to the trailer, with all of us chasing after him.” Particularly discomfoting for Carrey were the sclera contact lenses that covered nearly his entire eyeball, leaving only a hole around his pupil and a blurry ridge of the yellow-colored lenses around the corners of his vision. “The fake snow sprayed on the set created dust that would get under the lenses and into his eyes. My eyes were hurting from the dust irritation, as well, and I had to wash them every night when I got home. But for Jim it was a no-win situation—if he took the lenses out on set it was just another chance to get dust on them, so it was better to leave them in.”

Rhythm & Hues created CG Grinch eyeballs for five shots in which Carrey had performed sans contact lenses, making use of a Jim Carrey head-scan model they had created for a shelved remake of *The Incredible Mr. Limpet*. Using Voodoo, an in-house 3D package, the team tracked, lit and rendered the CG eyeballs onto Carrey’s face. “We took the head from the Limpet test and cut out the bridge of his nose, his eyebrows and his eyeballs from the scan to give



Whoville’s only Grinch sympathizer, little Cindy Lou Who (Taylor Momsen), looks wistfully out her window toward Mount Crumpit—a view rendered in 3D by Digital Domain.



A shot load that doubled by the end of production led to the limited involvement of additional effects vendors. For a scene in which the Grinch reveals his two-sizes-too-small heart via an x-ray device, Centropolis Effects composited traditional cel animation into a bluescreen heart monitor.

us a tracking reference to position the eyeballs in 3D space,” explained R&H visual effects supervisor Edwin Rivera. “We rotoed where the green makeup stopped and the pink of his inner lids started.”

With the exception of this five-shot reprieve, Carrey endured the contact lenses, suit and makeup for nearly every shot in the film, which translated to hours and hours of time in the makeup chair. To help the actor through the 92-day ordeal, production hired an ex-Navy SEAL to coach Carrey in mental training techniques. “I’ve definitely put people through a lot more uncomfortable things than what Jim was put through,” reflected Baker, “but to sit in the makeup chair for ninety days is more than anyone could take. I think the trouble Jim had in the beginning was that it suddenly became very real to him—this was what his life was going to be for the next three months. But he accepted it and went on.”



Cindy Lou converses with her postman father, Lou Lou Who (Bill Irwin), during the busy holiday season. Initial makeup concepts for the Whos—which were a bit too literal in their interpretation of Seuss’ drawn characters—resulted in Whos that looked grotesque and unappealing. Rick Baker’s team conducted many tests before arriving at a final look for the Whos, which consisted of a raised nose, oversize ears, a muzzle and extra-long eyelashes. Imaginatively coiffed wigs were also produced in great number.

Occasionally, on a bad day in the Grinch makeup and suit, Carrey would implore Howard to try it—to walk a mile in his fur. One day, feeling obligated, Howard arrived at the studio hours before dawn, and emerged transformed, ready to spend the day directing as the Grinch. But first he paid a visit to Carrey in his makeup trailer. “The makeup was pretty good,” Howard noted, “so Jim didn’t recognize me. He just looked at me, nodded and turned away. Then I started talking and Jim did a double-take—he realized I’d come through!”

Carrey had another opportunity to commiserate about the trials of performing in the heavy makeup the day Eddie Murphy—in full oversized Sherman Klump makeup and costuming—dropped by the Whoville set. “Eddie was there, and then Jim came out as the Grinch,” recalled Baker. “So here were Jim and Eddie standing together, two giants of the profession, in rubber faces—and I made those faces! I watched that scene with a big smile on my face. I was in makeup-geek heaven.”

In terms of sheer numbers, the makeup assignment for the Whos was far more daunting than the creation of the film’s title character. As with the sets and virtual environments, the primary directive in devising the Who makeups was to keep things Seussian—an edict that proved particularly problematic with characters that looked cute on paper but turned out to be anything but when translated to live-action. “If you were to do a literal translation of Seuss’ drawings on a person, it would be horrifying,” Baker observed. “We did some slightly humanized versions of Whos—but they were monstrous, with long upper lips and noses between their eyes.” The makeup job was further complicated by the razor-thin lead time Baker had before the onset of first-unit filming—a mere six months, as opposed to the full year he would have preferred.

Cinovation began its Who design work by producing a series of clay maquettes; but, realizing that Ron Howard and the producers would best be able to evaluate potential designs by seeing real people in makeup, Baker soon turned to producing test makeups on Cinovation crew members, as well as on himself. Since the Grinch cast would include child actors whose work hours were legally restricted, Baker also experimented with a more basic, time-friendly makeup of false teeth and wigs on his two young daughters.

After making select lifecasts and getting his performers into padding, costume and makeup—which ranged from subtle and human to fantastically Seussian—Baker videotaped the results and showed



A hundred or more Whos were needed for certain crowd scenes—such as the gala Whobilation celebration—and each required all-new makeup appliances for each day of filming.



To handle the daily mass-application of makeups, production filled a Universal soundstage with sixty makeup stations, built to Baker’s specifications and manned by sixty-five makeup artists from throughout the film industry.

them to Howard and Grazer. But Howard, who was still working on Ed-TV at the time, was not ready to give Baker a definitive direction in which to proceed. "Ron's head was still in Ed-TV-land," Baker commented, "but I was already in panic mode because time was ticking away. It's a common problem because of the long lead time I need."

Another problem was that while Jim Carrey had been signed to play the Grinch, production had not yet finalized the cast of Who characters. "So much of a character makeup is based on an individual actor's face," explained Cinovation shop foreman Bill Sturgeon. "An appliance for an actor with a round face will stick out if it's used on an actor with hollow cheekbones, for example." The care required to produce such prosthetic pieces—in particular pieces that would meet Rick Baker's exacting standards—made for an extremely time-consuming process. "When you inject foam latex into a mold, sometimes there will be a little air bubble—which normally wouldn't be a big deal. But Rick demands that makeup look perfect for a closeup; and because the appliances went straight onto the faces of the Who performers, in closeup, any wrinkles or puckers would be ten feet tall on the screen. It might take four runs of foam latex to get one really good piece."

The large quantity of makeup appliances required for a cast of ninety-some Who performers was another daunting aspect of the makeup effort. "The Who appliance edge had to go down to nothing and taper off really thin onto smooth skin so there wouldn't be a bump when the piece was glued down," Sturgeon noted. "That edge is ruined when you take the appliance off at the end of the day. That meant that the Who actors would need a new appliance for each day of shooting."

When Howard finally chose a Who makeup—a design featuring a decidedly Seussian muzzle and raised nose—Cinovation began mass-producing appliances from lifecasts on hand, producing generic pieces for test makeups. The artists were about three months from shooting and were well into tests with these pieces when Baker received a call from Howard. "He said that people who had seen the makeup tests thought the Whos were too scary," Baker recalled. "They wanted to change the look. So we had to throw out two months' worth of work and start again with a less scary concept." Working around-the-clock shifts, the Cinovation crew delivered the new concept while still making good on their original deadline. The new design had a less stylized, more human look, making the Who women, in particular, seem more attractive and less freakish. Final makeups for principal Whos included the muzzle, extra-long eyelashes, and large noses and ears, as well as body prosthetics to create big bosoms and butts—so big, in fact, that special restroom units with extra-wide doors had to be set up near the soundstages. A principal Who makeup could take two to three hours to apply. Supporting characters, such as those played by the acrobatic Cirque Du Soleil performers, received a basic makeup consisting of muzzle and large ears and eyelashes. In addition to those generic appliances, the supporting Whos were fitted with custom teeth and wigs. Overall, supporting Who makeups could be done in half the application time required for principals.

Originally, one-piece masks had been determined sufficient for third-tier background Who characters, and the Cinovation crew had started filming equipped with same. But a problem emerged in the early days of shooting when the masked Whos began drifting from the backgrounds into the foregrounds of scenes. "You wouldn't notice it during the shoot," said Baker, "because you'd be concentrating on the principal performer. But the next day in dailies you'd see this guy in a mask, standing right behind the main performer, trying to get on camera! It was kind of scary because the Who masks were set in fixed expressions. I told Ron we had to rethink the masks,

because this wasn't going to work." The solution was to replace the Who masks with a generic makeup—generally, a painted nose and oversize eyelashes.



Digital Domain increased the population of Whoville by computer generating hundreds of Whos that were used extensively to fill in background areas. Townsfolk gather for the Whobilation in a shot peopled entirely with CG characters. Principal photography had wrapped when Ron Howard requested the shot. Digital Domain took a clean plate that had been shot for a later town square sequence, frame-averaged it to eliminate film grain, then added the CG Whos.

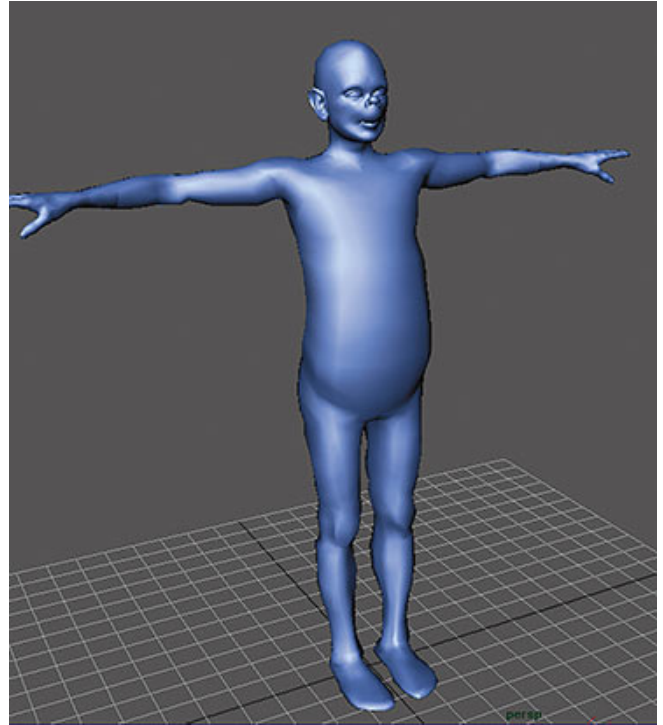


An in-house 'Who Construction Kit' enabled Digital Domain to mass-produce Who extras by modifying generic male, female and child prototypes, obviating the need to model each character separately.

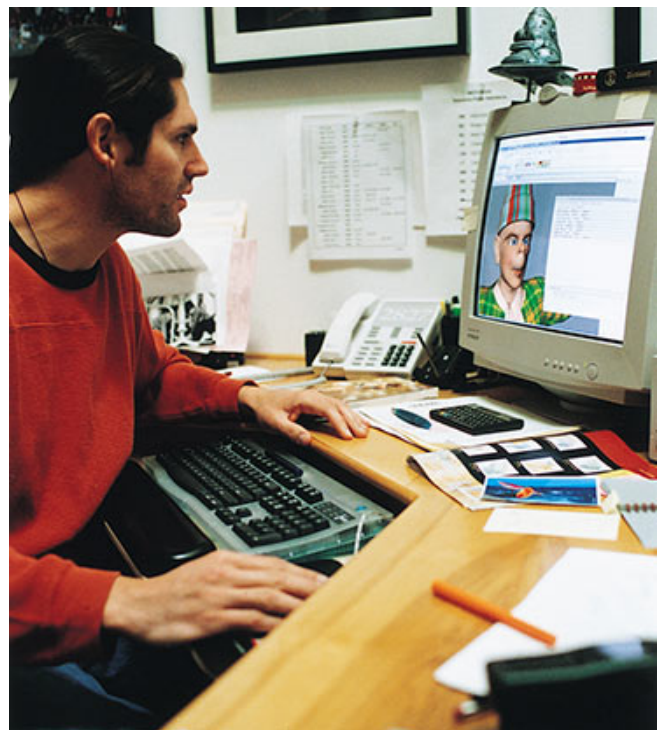
A team of sixty-five makeup artists, gathered by Baker from throughout the industry and trained at Cinovation, handled the makeup application and costuming of as many as ninety Who performers on a daily basis. Toni G. assumed the general supervisory and liaison duties, working with a Cinovation team that included Amanda Llewelyn and Kim Romero. Another key contributor was head wig maker Sylvia Nava, who produced 150 exotic wigs, hair pieces and the Grinch hair suits on a tight schedule. "Sylvia had experience with what she called the 'old-timers,'" Baker remarked, "people who had worked at Max Factor in the old days when they had a wig company. She got a lot of these people out of retirement, and they worked at home at night making wigs for us." Cinovation staffers Claire Flewin and Maria Sundeen designed and fabricated all of the Grinch spandex suits, while Jim McLoughlin headed the mold department. "Jim and his exceptional crew produced hundreds of molds for this massive undertaking."

Before the actual first-unit work began, Baker called a meeting of Grinch producers and assistant directors to review the logistics of getting the ninety-plus Who performers into makeup every day. In response, Terry Scott's construction crew built sixty makeup stations to Cinovation's specifications on a Universal soundstage. The stations, which measured six feet wide and eight feet tall, were made of particle board and built back to back, wired for electrical power and equipped with shelving for supplies, mirrors and fluorescent lighting to properly illuminate the makeup. Toni G. also organized a large storage room staffed with three people who ensured that each station was delivered fresh makeup supplies daily.

While each appliance was made with a special classification number, tracking everything by computer proved problematic given the vagaries of the filmmaking process. "A lot of times, production wouldn't know until 11 o'clock at night what they were going to shoot the next day," recalled Bill



Animators employed low-rez 'proxy' Who figures to work out the basic animation for a scene, then replaced them with their high-resolution counterparts.



Computer graphics supervisor Matthew Butler finalizes a digital Who. Wardrobe, props, hairstyles, even different body shapes could be assigned to the basic models through a user-friendly interface.

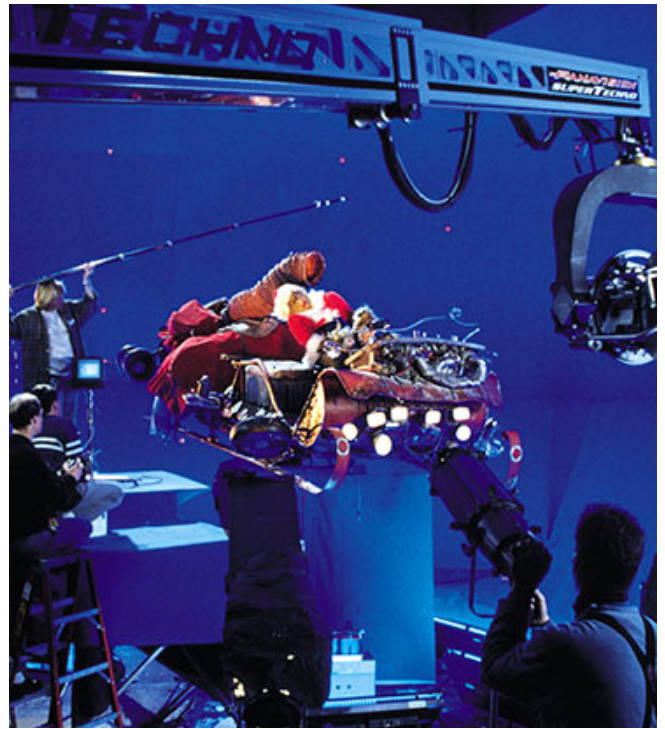
Sturgeon. "While we were doing Grinch, the biggest makeup show ever, we were also doing *Nutty Professor II*—which was the second biggest. Our foam department, headed by Roland Blancaflor, managed to keep up with the absurd schedule, creating appliances for both projects by working day and night to produce thousands of exceptional foam pieces. There was a lot of working until two o'clock in the morning—then waking up at four o'clock and thinking, 'Oh, I forgot the neck!'"

Despite occasional late-night misgivings, the makeup effort ran smoothly. "It was a makeup extravaganza," said Toni G. "We had all the time-scheduling scenarios in a 24-hour day listed on a big board at Cinovation. We'd figure out the different rotations and how many artists it took to do that many people. We also prepared continuity sheets so that each artist would know what they had to do for a particular character."

One of Baker's biggest concerns—that a soundstage full of make up artists working long hours would become grumpy and contentious—proved unfounded. Harmony reigned, and makeup crews were energized by the excitement of working with the best in the business on an historic makeup production. Who performers enjoyed a convivial atmosphere, as well. A kind of Who community sprang up, with performers in makeup congregating around a Who lounge during the down times to play cards or sleep with straws stuck up the nostrils of their prosthetic noses. "I work in movies for that kind of stuff," remarked Sturgeon. "You'd go to Universal and there'd be a whole group of Whos standing outside a stage, or a Who driving by in a little Who-car. Then, walking on stage, you'd see Whoville in three dimensions and 360 degrees."

By the time postproduction was heating up in the summer months prior to the film's release, Baker had already moved on to Tim Burton's *Planet of the Apes*—yet another makeup extravaganza. "If I hadn't had the experience of Grinch," observed Baker, "I would have said there was no way I could do *Planet of the Apes* in the time frame we were given. But Grinch gave me the confidence that we could do a lot of stuff very quickly."

Since even the ground-breaking numbers of actors in makeup were not enough to fill the frame for



Seeking to avenge years of perceived ill treatment by the Whos, the Grinch decides to steal Christmas, disguising himself as Santa Claus and descending Mount Crumpit—with his surrogate reindeer Max—in a rocket-powered flying sleigh. To capture closeups, production shot bluescreen elements of Jim Carrey in a full-size sleigh, mounted to a motion base by special effects supervisor Allen Hall.



For a shot of the sleigh taking off, the prop conveyance was suspended on cables from a crane over the exterior Mount Crumpit set. During postproduction, Digital

larger crowd scenes, Digital Domain created hundreds of computer generated Whos to populate both the practical and digital sets. In addition, CG Whos appeared in foreground scenes that would have been difficult or impossible to achieve with real performers—such as those featuring the tiny Pee-Wee Whos. In several shots, all of the characters in the scene were synthetic.

Domain removed the cables digitally, then added CG smoke, engine flames and snow above. The sleigh, carrying Currey and the dog, was again suspended from a crane, this time over a rooftop set erected on the Universal backlot. Digital Domain added computer generated smoke and flame, plus background Whoville, while eliminating visible crew members and the city of Burbank from the plate photography.

The digital performers had their genesis in scans made from Cinovation lifecasts and prosthetic body appliances. But back when Digital Domain was first bidding the show, Kevin Mack and the Grinch character team—headed by character animation supervisor Randall Rosa—had contemplated a system for creating CG Whos that avoided having to laboriously model, rig, weight and texture every character individually. “What we wanted to achieve was something similar to a genome,” stated Mack. “We wanted to define a sparse set of attributes, or genes, which described large-scale, graphic changes in an organism—in this case, the Whos.”

The team implemented a virtual assembly line for producing an endless variation of characters derived from prototypical models divided into basic male, female and child Whos. “Normally,” said technical lead Dan Lemmon, “when creating a new character you’d first model the character in its entirety, then draw in a skeleton and rig animation controls. Next, you would assign controls for how the skin and clothing deformed, based on the joint movements; and, finally, you’d assign shaders and textures to your model. But that process would have been too labor-intensive for hundreds of characters. With our approach, we could modify proportions and put different pieces together using a base model, without having to go through the modeling, rigging and weighting processes for each character.”

Lemmon and technical director Darren Hendler engineered the in-house system, dubbed the ‘Who Construction Kit.’ “We added a plethora of controls in order to modify the under lying structure,” Lemmon noted, “but in such a way that we did not have to re-set up the characters. We could get dramatically different shapes and even morph between shapes to dial in things such as age wrinkles and sagging chins.” An appealing aspect of the construction kit was its user-friendly design. “We used Maya’s scripting language, MEL, to generate a custom interface that removed the unnecessary technical aspects of the process. It was so straightforward even our texture painters could create Whos. Without this setup, the technical issues would have been too overwhelming.”

A database listed each model pictorially. “Since the actual generation process of building up a character—putting on the weighting maps, skeleton and facial controls—can take time,” explained Darren Hendler, “we created script files to generate a series of characters overnight. The next morning there could be thirty, forty or more characters ready and waiting, with their little pictures rendered to the in-house Web page. The animators could go to that page and choose from a whole range of characters.” Artists also selected clothing, hats and props from a database of prefabricated models with associated texture maps and color swatches. Even if a character’s body changed radically, the clothing would automatically adjust.

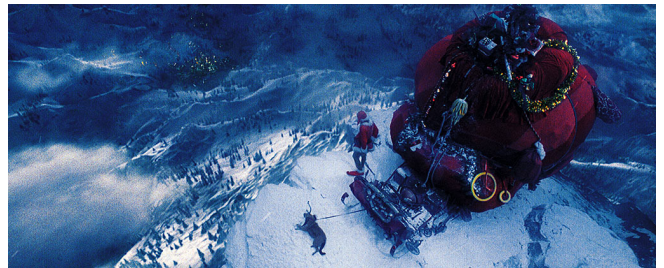
To avoid the cumbersome matter of having to animate many high-resolution characters in a scene, animators would work out gross movements on low-rez 'proxy' characters before adding in the high-rez versions. "Our tracking team would first reproduce the camera moves and set the environment with the background plate," explained Randall Rosa. "Then we'd work with a proxy character, which didn't have a name, body type or hair style. Sometimes we'd scale our generic puppets heavier if the final character was going to be physically big, just to make sure the interactions with the surroundings were appropriate. Martin Costello created this fantastic animation system that allowed us, at any time, to swap in our high-rez character to check the animation. But usually we'd wait until the end to do the fine-tuning and substitute in the high-resolution character with all its textures assigned."



With gleeful malice, Santa Grinch proceeds to relieve the Whos of their Christmas gifts and trappings, employing such fanciful aids as a high-power vacuum tube. Rhythm & Hues assembled the rooftop shot—which entailed sky replacement and the removal of a bungee rig used by Jim Carrey to perform a triple somersault down a Who chimney.



An awakened Cindy Lou Who catches the Grinch in the act of stealing the family Christmas tree.



Having returned to Mount Crumpit with a sleigh full of stolen loot, the Grinch eagerly awaits the sound of Who mourning from below. Computer generated imagery supplied the breathtaking view, which Digital Domain composited with live-action footage of Carrey and the prop sleigh on a mountaintop set piece.

Once the animation was approved, the team could move on to adding high-rez clothes, accessories and props. Martha Snow Mack worked in cooperation with Grinch costume designer Rita Ryack to photograph and scan the production war drobe, and those images served as the basis for a virtual wardrobe library. “Our cloth animators—mainly Andy Hall—made sure the cloth was moving correctly and the textures were right,” stated Rosa. “Then we’d render it out and give it to the compositors for the final integration with all the elements.”

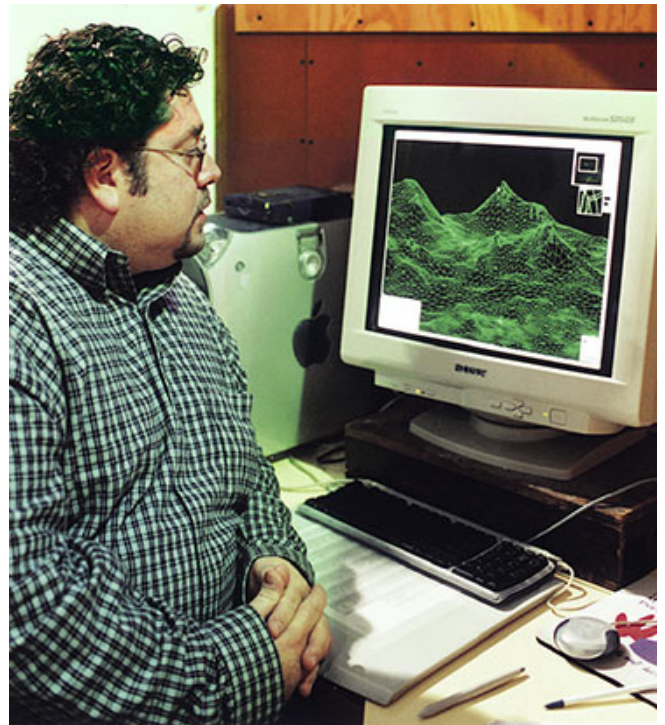
Lines of communication were established between animators and lead character compositor Donovan Scott so that rough com posites of the scenes could be evaluated throughout the animation process and, when necessary, characters could be retooled to better blend into a shot. “If, say, we were seeing too much of one particular jacket,” noted Lemmon, “or if a certain color wasn’t appropriate for a shot, Kevin Mack or the director could ask to see a different jacket and we could drop it in using the construction kit. Those sorts of changes would have been painful using a traditional pipeline. With our system, it was as easy as paint-by-numbers.”

Both the digital performers and those sporting Cinovation makeups came together on stage and virtual sets to tell the forty-year-old story of how the Grinch, one year, stole the Who Christmas. The movie opens with a flight into a snowflake, a motif that echoed Dr. Seuss’ *Horton Hears a Who!*—published three years before *How the Grinch Stole Christmas*—in which an elephant discovers an entire Whoville populace abiding in a speck of drifting dust. “Todd Hallowell suggested making it a snowflake instead of a speck of dust,” said Kevin Mack. “I loved the idea. And doing it as one big establishing shot—through the snowflake and right into the Who world—was a tremendous creative opportunity since it set the look of that world as well as the spatial relationship between Whoville and Mount Crumpit.

It was the first shot we started with and the last shot delivered—a difficult and complex compositing



A bluescreen behind the stage set facilitated the addition of the digital vistas.

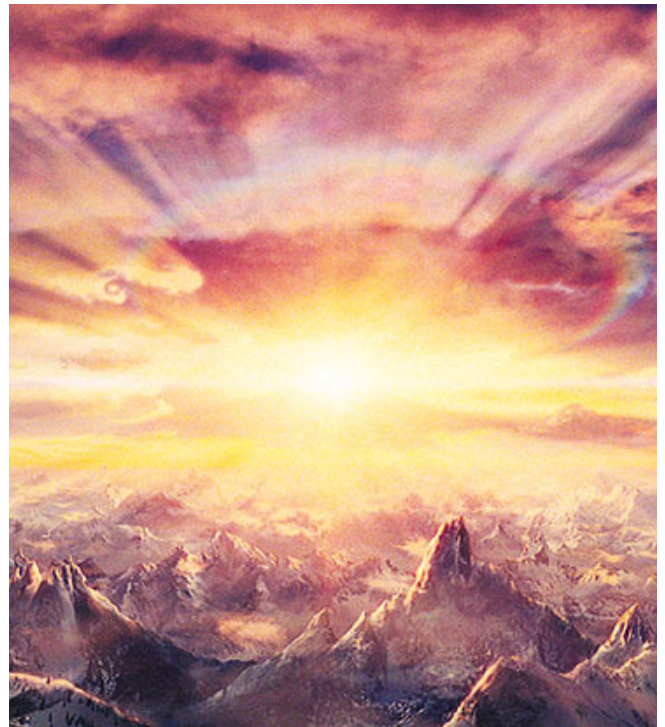


Compositing supervisor Bryan Grill studies mountain peaks in wire-frame form.

job handled by Jodi Campanaro and Claas Henke. Ron wound up having us create a reverse version for the end of the film, as well.”

Mack designed the snowflake interior, an ice cave of curved and twisting Seussian shapes covered with faceted crystals and frost. Photographic reference, from glacial ice caves to geological crystal structures, provided a source of inspiration for the magical environment, the geometry of which was created as an iso surface—a surface determined by a function description. “I use isosurfaces extensively in my fine art,” Mack noted. “I also used them in the brain pullback shot in *Fight Club*. By combining various frequencies of turbulent noise in the function, you can create complex organic forms of any description.” To provide the actual look of the snowflake interior, Johnny Gibson wrote a crystal ice shader containing all sizes of faceted crystals and frost, as well as areas of smooth translucent ice.

Also in the snowflake interior are dozens of massive cumulus clouds that hover and cling to the cave’s surreal shapes. Digital artist John Courte produced volumetric clouds using a proprietary tool developed by Alan Kapler. “With a volumetric cloud representation,” observed Mack, “you can actually go into the cloud; so light is attenuated realistically. You get light beams and complex, soft self-shadowing because it’s actually simulating the light passing through a volume of varying densities. We employed volume clouds in a lot of shots where we needed 3D atmospherics, and also for the inversion layer clouds on and around Mount Crumpit.”



The Grinch experiences an epiphany when he hears, not wailing, but joyful singing rising from Whoville. Digital Domain added visual impact to the scene with a digital sunrise comprised of many painted elements. The layered images were manipulated individually to produce 3D perspective shifts.



The Grinch's new-found sense of goodness is challenged when the sleigh—with Cindy Lou aboard—begins to slip over the precipice. Digital Domain enhanced a stage element of Jim Carrey holding onto the sleigh, extending and relighting the set piece and adding a CG background.

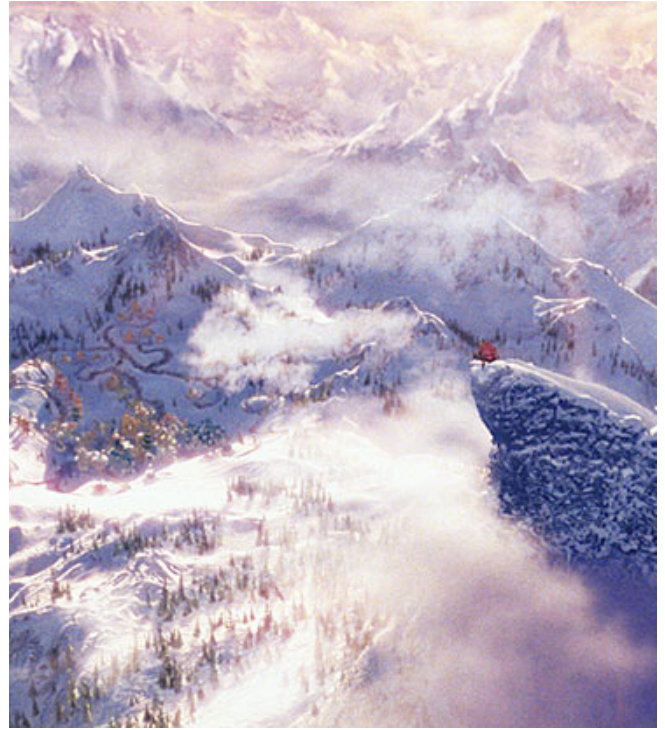


Empowered by his swollen heart, the Grinch pulls the sleigh from the cliff's edge and lifts it over his head. On the mountaintop set, Carrey lifted a flat blue grid which was later replaced with a Digital Domain CG sleigh.

The camera reveals alpine mountain ranges, the village of Who ville and Mount Crumpit as it moves through one of these volumetric clouds. Within Crumpit is the isolated cave-home of the Grinch where, early in the movie, the hairy hermit puts an x-ray monitor to his chest, revealing an undersized heart. Centropolis Effects did compositing work for the scene, adding cel animation art—courtesy of David Spafford and Spaff Animation—into a bluescreen heart monitor prop held by Carrey. The cel animation revealed a shriveled heart, broken ribs, and a fork and nail lodged inside the misanthrope’s body. Centropolis embellished the final composite with rippling static as the Grinch turns the monitor knobs and tunes in. “We had the plate and bluescreen,” stated Centropolis digital effects supervisor Conny Fauser, “and tracked the heart in to this flat screen. Production asked me to add static for when the Grinch turns on the monitor. That alone looked a bit too clean, so then I added flicker and a black line every twenty-four frames.”

In another revealing scene—flashing back to the day of the Grinch’s birth—umbrellas holding individual baskets of Who babies drop out of a magical night sky. The baby Grinch’s bad attitude is revealed, as he bumps another drifting umbrella out of the way. Also apparent is his bad luck—instead of landing softly on a front porch, as do the other Who babies, the Grinch lands in a tree outside the old biddies’ house, where he spends a long, cold, shivering night.

At Digital Domain, John Courte created a flock of procedurally animated drifting CG umbrellas for three huge shots that relied on an ambitious use of pan-and-tilt. “From way up in the air we see the whole Seussian landscape at night,” Mack noted. “In one of the shots, we pan 240 degrees on our completely virtual world to see craggy, snow-capped peaks and thousands of trees. Little clouds are everywhere, drifting along in perspective, with distant Whoville’s Christmas lights glowing onto the foot of Mount Crumpit. As the practical Grinch umbrella comes by camera, we do a little rack focus



The camera pulls back in an all-digital shot revealing the whole of Mount Crumpit, Who Valley, Whoville and the surrounding mountains.



on the CG background for added realism. The shots, composited by Feliciano di Giorgio, are so beautiful, they have a storybook quality to them—but with the illusion of a vast and real world.”

For closeup views of the sleigh-lifting feat, Carrey mimed the action with the practical sleigh, which was hanging from the stage ceiling.

Cinovation brought the baby Grinch to life, with Rick Baker sculpting the head and Aaron Sims sculpting the body for two two-foot-tall foam latex puppets. One, a radio-controlled version built for faraway shots, was used in a practical basket and flown thirty feet off the ground on a bluescreen stage for compositing into the scene. A later scene of the infant Grinch in a highchair featured a closeup baby, designed with both radio- and rod-control capabilities. The bottomless chair allowed rods to pass up and through so a team that included Bill Sturgeon, Jurgen Heimann, Tim Blaney and Nick Esposto could manipulate the head, arms and hands, while Baker operated a radio-controlled eye box. Head mechanic Mark Setrakian controlled a servo system he had developed for *Mighty Joe Young* that provided realistic lip sync. Puppeteers caught in the highchair shot by the production’s moving camera were later painted out by roto and paint artist Tom Lamb at Centropolis.

Rhythm & Hues embellished the baby scene, one of several flashback vignettes, with an oily border. “Ron wanted to create a feeling of taking you into the Grinch’s mind,” stated Edwin Rivera. Rhythm & Hues also provided wipes for scene transitions, with old images either pushed out or made to fall out of frame. A ‘snow wipe’ motif featured a scene blown off like snow particles dispersed by the wind. “Using Houdini, we created a black-and-white particle pass, which we then used as a matte element for the ‘A’ side of the transition. As the CG snow animated in the matte channel, it revealed the ‘B’ side.”



The Grinch takes a joyous sleigh ride down Mount Crumpit to return the Whos’ Christmas. Production had planned to capture much of the sleigh ride practically, with a stuntman driving a toboggan-style sleigh down a snowy trail on location in Utah. Ultimately, only one such shot made it into the finished film—and even that was digitally enhanced.

Saddened by stories of the Grinch’s unhappy and reclusive childhood, little Cindy Lou Who (Taylor Momsen) nominates him as Whobilation festival ‘Holiday Cheermeister’—an honor the Grinch reluctantly decides to accept in person, descending from Mount Crumpit via a trash system tunnel slide. The slide effect combined a CG tube created by Digital Domain and a steel rotator rig built by the special effects squad and photo graphed against bluescreen. “The rig had a seat Jim Carrey sat on,” said Allen Hall, “with an axle-bearing in the back that you couldn’t see. He could lie on his belly or on his butt and the rig would rotate him 360 degrees, flip him upside down or swing him back and forth as if he was going down the tube.”



The bulk of the sleigh ride shots consisted either of motion-base sleigh elements placed into CG backgrounds

The Grinch pops out of a trash can in Whoville, a sequence broken into a series of special effects shots, with pneumatic rams popping up the trash can lid and wires flying either Carrey or a stunt Grinch into the midst of the celebration. One of the

or shots in which all of the elements—including the sleigh and its occupants—were computer generated. Digital Domain used displacement maps to deform the snow behind the sleigh and leave tracks as it raced down the mountain.

flying rigs, used for a shot of the Grinch bouncing into a drum, was designed like a medieval catapult with a seat strapping in Carrey and swinging him six to eight feet off the ground. “The rig was counter-balanced so the operator was only moving about twenty pounds,” Hall explained. “Since the rig could be filmed from an angle that obscured it, it didn’t have to be digitally removed.”

Ridiculed by the Whos in his moment of glory, the Grinch declares war by taking a swig from a bottle of alco hol, grabbing a lit torch, and blowing a fireball that in seconds reduces Whoville’s enormous town Christmas tree to an ashy skeleton. The treetop star hangs suspended for a moment before—poof!—the tree collapses and the star lands with a thud. Digital Domain 3D animator Danielle Plantec and technical developer Greg Duda created the collapsing tree using L-systems and particle effects in Houdini, as well as some extensive shader tricks. Lead digital compositor Mark Larranaga com posited these CG elements —along with CG Whos, CG buildings and practical fire elements—into the plate photography. Allen Hall and his crew created the fire elements, with spiral cylindroids blasting pro pane up a black tree. In the final composite, the spiral fire element wiped out the set piece as it traveled upwards, leaving the CG ash tree and star.

Back on Mount Crumpit, the Grinch hatches his plan to steal Christmas by impersonating *Santa Claus* and making a Christmas Eve raid on every house in Whoville. The actual sleigh trip down the mountain was a twist on the original Seuss story, featuring the Santa-suit-clad hermit in a rocket-powered sleigh of his own devising. The rocket sleigh was a CG model created at Digital Domain by 3D modeler Melanie Okamura, with textures provided by the shader team. The digital artists created the CG sleigh to match a practical version built by the special effects unit for stage work—such as closeup shots of Carrey-as-Grinch struggling to control the careening sleigh. Hall’s crew built that practical sleigh, some fifteen feet long and five feet wide, out of steel, fiberglass and aluminum, then mounted it onto a motion base surrounded by bluescreen.

In order to maintain proper physical dynamics and appropriate lighting, even some of the stage closeups wound up placed inside the CG sleigh, with Digital Domain isolating Carrey out of the practical element and tracking him into the virtual one. Digital compositor Dave Stern assembled many of these tricky flying sleigh shots. At one point, as the sleigh skims over the trees and rocky terrain of Mount Crumpit, Max, the Grinch’s dog, is dislodged, and spins around the corkscrewing conveyance be fore finally dropping back inside the cockpit. “The environment for that sequence was entirely CG,” said Kevin Mack. “We also added backfiring rocket exhaust, volumetric atmosphere, and a CG Max flying out of and back into the sleigh.”

Once in Whoville, the Grinch carries out his dastardly plan to steal Christmas. A variety of gags were devised by the special effects unit to suggest the cartoonish methods employed by the Grinch in the animated version of the story. One was a vacuum tube that could suck up the accouterments of Christmas cheer. Hall’s crew utilized a bank of eight twelve-foot hydraulic reverse rams for the gag.

By attaching a wire around an object and adjusting for pressure, any object—even a couch or refrigerator—could be whisked away. “We could press a button,” Hall recalled, “and literally pull something twenty-four feet across a stage, making it disappear out of camera.”

As in the original Seuss drawings, the Grinch’s sleigh bag swells to outlandish proportions as he goes from Who house to Who house, stripping them of Christmas trappings and hauling the booty away. A practical sixteen-foot-diameter bag, used in connection with the stage sleigh setup, was originally intended to be filled with styrofoam. But Hall had expressed concern that a bag that large, even filled with lightweight foam, would be deceptively heavy and potentially dangerous—particularly in concluding scenes of the Grinch joyfully riding the sleigh back down Crumpit, during which the rocking action on the motion base could easily make the bag topple. As a safety precaution, Hall ordered several inflatable vinyl balloon bags from Createable Inflatables, a Los Angeles-area company, for use as a light-weight alternative.

His sleigh full, the Grinch prepares for the return to the top of Mount Crumpit. With the rocket engine out of fuel, however, it is up to Max to pull the sleigh up the snowy mountain—a sequence Digital Domain dubbed the ‘Max Mush.’ A classic wide shot of the dog pulling the sleigh and its massive payload up the steep side of Mount Crumpit was entirely CG, as was the dramatic down-angle of Max collapsing as the sleigh comes to a rest at the top of the peak.

For practical shots on stage, the special effects team utilized roller coaster technology, laying down two sixty-foot pieces of track on the Crumpit peak set. One tracked uphill for the Max Mush shots, while the other started at the top of the peak and terminated at a cantilevered precipice. Allen Hall’s special snow machines furnished a thick dressing of foam to hide the tracks. Motors operated by hydraulic joystick controls were used to move the sleigh along the tracks. Thus, the sleigh on the uphill track could be ‘pulled’ by Max and, later, positioned on the teetering cliff-edge track.

With the sleigh in its precarious stance atop the precipice, the Grinch gleefully awaits the ‘boo-hoos’ of the awakening Christmas-less Whos—but, instead, is greeted by the sound of their joyful singing. Christmas, it seems, came—without the trappings and wrappings and presents and feast, it came just the same. In a moment of pure epiphany, the Grinch’s shriveled heart grows several sizes, and the dark skies break into a beautiful, light-filled dawn. Swirling around the Crumpit peak in the pre-dawn sequence was a virtual, top-of-the-world view created by Martha Snow Mack—one of many 22K-by-8K paintings she rendered. “For the shots leading up to the epiphany,” observed Mack, “I thought it would be cool to keep them very dark and moody, so when the sun does break through, we would feel the same emotional lift that the Grinch does.” Bryan Grill and his compositing team moved and manipulated the many painted cloud layers for the shots, and also tweaked set photography. “Because we were creating the entire sequence,” noted Grill, “we were able to go in and color-correct-down the set photography, which was shot with bright morning light. This allowed us to match the mood of the sky Martha created.”

The sequence culminates in the Grinch’s epiphany—a point-of-view of the sun coming out from behind the clouds and illuminating the Seussian landscape. Claas Henke blended dozens of Martha Snow Mack’s painted elements with practical smoke elements, then applied 3D transformations to make them move in perspective as the sun rises, lighting up the sky. “The Grinch looks at this dark gloomy sky,” noted Grill, “and then it separates and becomes beautiful. He’s literally seen the light.”

As the sleigh begins to slip off the precipice—with a stowaway Cindy Lou aboard—the Grinch, emboldened and bursting with the newfound love and energy of his swelling heart, intervenes, pulling up the sleigh and lifting it triumphantly over his head. “For closeup shots of the Grinch holding the sleigh up,” explained Kevin Mack, “production suspended it from the ceiling. But they couldn’t fit the sleigh above the large peak set for wider shots. So, for the big reveal shot of the Grinch lifting it, sequence lead Markus Kurtz tracked in the CG sleigh. We also put in a CG Max, snow, sky and terrain.”

“Jim Carrey was just holding up a flat blue grid on stage for that shot,” added Kurtz, “and we tracked our CG sleigh on top of that. Of course, the grid he was holding was nowhere near the weight of the sleigh, so there was a lot of high-frequency motion translating into the CG sleigh, which made it look too light and fake. We got rid of the frequencies to make the sleigh look heavier. But since the high frequencies were still in his hands, we then had to morph them to make them match the now low-frequency movement of the sleigh.”

As the Grinch holds the sleigh, trophy-like, above his head, the camera pulls back in a wide helicopter-style shot to reveal the whole of Mount Crumpit, Who Valley, Whoville and the surrounding mountain ranges. Christine Lo composited a multitude of computer generated elements for the all-digital shot. “When Danielle Plantec was doing some previz for CG shots,” recalled Mack, “I asked her to do this big ‘Sound of Music’ pullback. It wasn’t storyboarded or anything, but I felt we needed it to get some scope and a bit of a geography lesson. I pitched it to Ron and editor Dan Hanley, and they loved it.”

The reformed Grinch, determined to return Christmas to the Whos, hops back on his sleigh for a joyful, wild ride back down the mountain, with Cindy Lou and Max hanging on for dear life as the top-heavy sleigh careens towards Whoville. The production had originally hoped to get as much as it could of the forty-plus-shot sleigh ride from a Utah location shoot, orchestrated by the special effects and stunt crews. The live-action shoot presented tremendous challenges to Hall’s team, such as refitting the sleigh—which had been equipped with golf cart mechanisms for stagework—with a snowmobile chassis so it could be transported up and down the mountainside. However, when it arrived—just four days before shooting was scheduled to start—the effects team discovered that the stage sleigh was nearly useless in the real snow. “This thing had never been on snow before,” Hall remarked. “When we got to Utah and put it on the snow, it wouldn’t even move! The pressure was on.” Hall and his crew spent all night modifying the stage sleigh to make it a freefalling toboggan-style vehicle. “We expanded the width of the sleigh skis, so they weren’t digging into the snow from all the weight but almost floating on top of it. Also, the snowmobile’s brakes weren’t strong enough because we had added 2400 pounds of sleigh; so we installed a claw hidden underneath the sleigh at the back and a safety cable. When a pedal was stepped on, this claw would jam into the snow, bringing the sleigh to a halt.”

Another problem encountered on location was that the internal motors that usually kept the inflated balloon sleigh bag swelled to its full diameter did not work in Utah’s freezing temperatures and 8000-foot elevations. Hall’s effects crew had to install special generators to keep the bag fully inflated. A ‘blind driver’ setup within the bag allowed sleigh driver Charlie Cromwell to see both front and back via video monitors. “Between the new brakes and his excellent driving ability,”

commented Hall, “Charlie was able to control the sleigh very well. He got so good at it that the filmmakers became more and more bold with the sleigh, making it race in and out of trees, around rocks and down hills.”

Only a handful of the Utah shots wound up in the final film. The majority would feature closeup bluescreen elements shot on the motion-base rig composited into fully CG backgrounds. “The original plan,” stated Markus Kurtz, “had been to shoot the foreground motion-base sleigh and add the background plates from Utah. But for purposes of continuity and art direction, we ended up using all-CG backgrounds.” In fact, even the four shots from the practical unit that made it into the movie were modified digitally to tie into Digital Domain’s virtual location. “Normally,” noted Mack, “we have to match CG shots to a practical location. But for the downhill sequence, we wound up modifying the four Utah shots to match our CG world.” Mack, Kurtz and Matthew Butler mapped out the weather and lighting conditions all the way down the CG Crumpit’s curvy slopes, designating sunlit areas and shadow patches under the ever-present clouds for their CG backgrounds.

Twelve of the forty-four shots in the sleigh ride scene would be entirely CG, with a digital sleigh being animated into computer generated backgrounds. “For animation purposes,” said Kurtz, “we brought everything over to Houdini and devised a procedural system that let us animate the sleigh without any key-frame animation. We ended up writing our own tools to make the sleigh move realistically in its velocities and accelerations.” These all-CG shots also featured digital performers. For the CG Grinch, Giancarlo Lari pulled up a generic model from the Who construction kit and sculpted a special Grinch face. A digital Cindy Lou, based on the child Who prototype, featured a separate face sculpture. And both CG Grinch and CG Max received a digital comb job from 3D effects animator Juan-Luis Sanchez, who coiffed their mangy fur.

An animation program developed by Matthew Butler for the *Terminator 2: Battle Across Time* theme park attraction served as the basis for the forward velocities and accelerations of the careening sleigh. However, the system previously had been applied to airplanes and other flying objects only. Grinch marked the first time it would be used on terrain. After key-frame animation defined a rough path on the CG mountainside, the system could project that animation down with three green lines: the middle line providing the sleigh position at any given moment, the left and right lines the banking. The CG sleigh itself was also modeled with six shock absorbers, three on each ski and connected to the main frame, which would extend when it was airborne and compress when it hit the ground. “The system automatically read the point information and figured out the rotations,” noted Kurtz. “We’d know how the CG sleigh would realistically interact with terrain. We could derive the actual speed, whether it was moving fifty or sixty miles per hour or faster. Once we had information for the banking, I could derive all the information for what the bag was doing. It automatically provided the real animation for how heavy the bag should be and the accelerations on it. Gravity wasn’t complete in this system—the sleigh could tip, but we didn’t want it to crash or roll over. It would always look at the path it was told to follow.”

Once the sleigh animation was determined, ski-track snow curves could be created. "One of the coolest things we came up with were the sleigh and ski tracks in the snow," said Johnny Gibson. "After Markus Kurtz generated where the sleigh had been and rendered the frames from a projected top-down view, Darren Hendler took that information into the snow shader and projected it back on. Then we used it as a classification map to determine where to deform the snow."

For closeup trees, Digital Domain's sleigh ride team not only did a digital tree placement but implemented a displacement map that roughed up the snow shader wherever the trees grew, creating the look of wind-blown snow having fallen from the branches to the ground around the base of the trees. Throughout the sequence, snow lead Nikos Kalaitzidis added layers of falling snow and vortex effects for turbulence. Even the illusion of CG snow hitting and melting on the practical motion-base sleigh was created by defining an invisible CG sleigh as a collision object and doing a separate pass of snow particles realistically interacting with that object that could be rendered over the motion-base sleigh. These same techniques added falling and blowing snow to more than two hundred shots throughout the film, including those of the Grinch outside his cave.

The sleigh makes a safe arrival in Whoville, where the Grinch is given a hearty welcome—and is even bestowed the honor of carving the roast beast for the Christmas day feast. The ending mirrors that of the animated feature—the annual viewing of which has been, for many, a treasured ritual of the Christmas season for the whole of their lives. Perhaps it is the fondness with which that animated special and Dr. Seuss are regarded that made everyone on the Grinch feature feel as if they were involved in something special, something that might endure to become a new Christmastime tradition. "People worked very hard on this movie," Ron Howard concluded, "because they felt that it was a once-in-a-lifetime project. It was fun—and a rare opportunity realized for me as a director."

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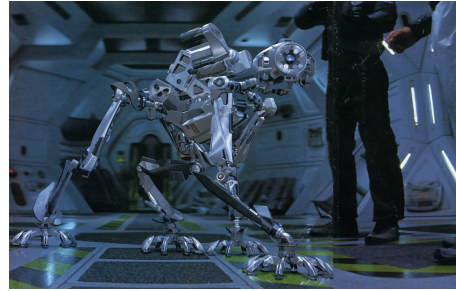
The spirit of Christmas is alive and well in Whoville, as its citizens gather at the town Christmas tree to sing songs of jubilation. The live-action plate had included only a small assemblage of singing Whos, the tree and part of the surrounding buildings. Digital Domain expanded the shot digitally in all directions, adding both foreground and background buildings, and then doubling the number of Whos.



*Concurrent with the production of *How the Grinch Stole Christmas*, Rick Baker was also at work on another big project, *Nutty Professor II*, creating distinct makeups for an entire family, all of whose members were portrayed by Eddie Murphy. Baker enjoys an encounter with two of his most challenging creations—the Grinch and Sherman Klump—as Murphy pays a visit to the Whoville set.*

RED SCARE

ARTICLE BY
KEVIN H. MARTIN



RED SCARE

ARTICLE BY
KEVIN H. MARTIN



A half-century in the future, mankind attempts to survive a dying earth by transforming Mars into a habitable planet. When a manned mission is sent to investigate failing terraformation experiments, most of its crew is marooned on the red planet's surface. Digital FilmWorks, one of a dozen Red Planet vendors overseen by visual effects supervisor Jeffrey A. Okun, treated nearly four hundred shots to produce the desired red coloration in the Martian skies and landscapes.



On location in Jordan – which, along with the Australian Outback, doubled as Mars for the production – director Antony Hoffman studies a setup.



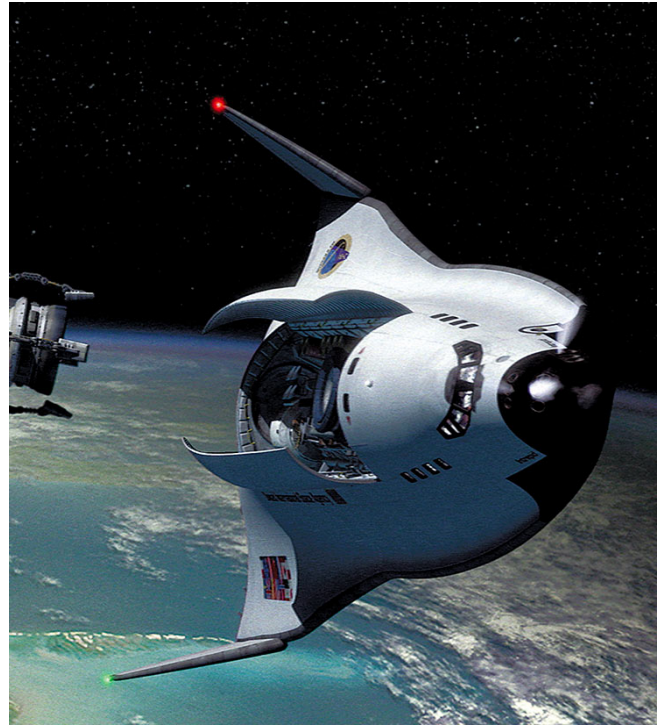
The ill-fated mission launches from a futurized version of the International Space Station. Through wholly digital means, Pixel Magic created the expanded station and the Mars 1 ship. Earth imagery was pieced together from NASA photos, then texture-mapped onto a 3D sphere and enhanced with layers of cloud and pollution haze.

Exploitation or exploration?

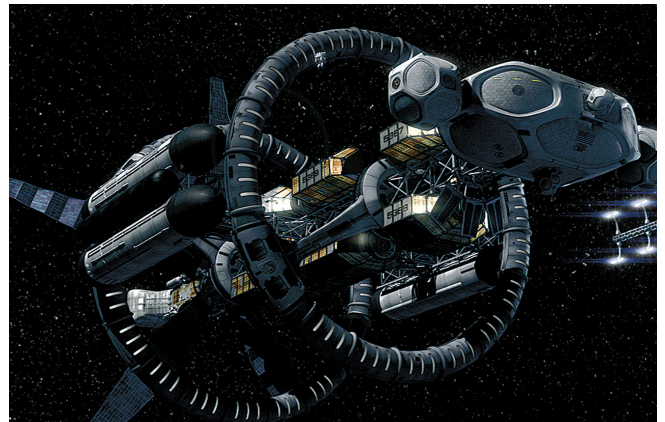
While any number of science fiction movies have postulated man's place in the cosmos as that of an explorer, in the purest sense, a more likely scenario – borne out by even the most cursory examination of human history – is that any off-world ventures will probably be driven by baser concerns, such as the acquisition of wealth. More elemental even than that, the best motivation for a manned odyssey into space might be a simple matter of survival.

Red Planet a Warner Brothers release, envisions a poisoned and dying earth in the year 2050, a world whose citizenry face the grim choice of either interplanetary emigration or extinction. Ironically, it is Mars, a world named for the god of war, that becomes the best and only hope for mankind's survival. Having spent more than a quarter century seeding the planet with unmanned probes that contain genetically manipulated lichen and algae, scientists have started the long process of altering the Martian environment towards something more hospitable to human life. But when such initially promising attempts at terraformation prove less and less fruitful, a manned mission is dispatched to Mars to investigate the cause.

In orbit around the red planet, the Mars 1 spaceship is damaged by a solar flare, forcing members of the crew to evacuate to the surface in the vessel's Mars Entry Vehicle, or MEV. Once there, life expectancy decreases drastically. Dr. Bud Chantilas (Terence Stamp) is fatally injured during the rough planetfall, while Ted Santen (Benjamin Bratt) falls prey to the murderous intent of fellow crewman Chip Pettengill (Simon Baker), who is later dispatched by a predatory robot named AMEE – for 'Auton-omous Mapping Exploration and Excavation Unit' While commander Kate Bowman (Carrie-Anne Moss) continues orbiting the planet in the Mars 1 mothership, surviving surface team members Robby Gallagher (Val Kilmer), the mission's mechanical systems engineer, and Dr. Quinn Burchenal (Tom Sizemore) struggle to make their way toward an ancient probe that could serve as a means of escape. Along the way, the two battle AMEE and encounter a deadly species of ravenous insect that, paradoxically, may provide the means for mankind's salvation.



Pixel Magic Also created a digital next-generation space shuttle for a docking scene.



The Mars 1 prepares for departure.

The show – which marked the feature debut of commercial director Antony Hoffman – was itself plagued with more than its share of challenges, right from the start. Of particular consequence was the fact that, due to its plot point of astronaut murdering astronaut, the production was denied the generous measure of cooperation extended by NASA to a rival project, *Mission to Mars*, then underway at Disney. When that picture eventually succeeded in staking out a release date in advance of *Red Planet*'s scheduled March 2000 debut, Warner Brothers opted to throttle back rather than rush through production to compete for essentially the same slot. As a result, *Red Planet*'s release date was pushed ahead to the summer, and then later to the fall and finally November.

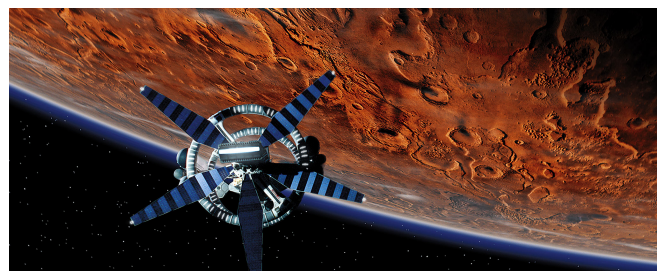
Development of the film's visual effects had begun, in part, at Digital Domain, which had a longstanding relationship with Hoffman, who had worked with its commercials division on a number of successful campaigns. Digital Domain visual effects supervisor Erik Nash oversaw preliminary effects design work and some early CG work, as well as construction and motion control photography of a twenty-two-foot-long Mars 1 spaceship, a quarter-scale space probe miniature, and various background elements including a Martian landscape, all crafted in the Digital Domain model shop under the supervision of Alan Faucher. Conceptual work was also underway at this time for additional unassigned effects, with Ron Gress serving as art director. Many of the effects sequences were left open-ended and subject to future agreement, pending design approval by the director, the production and the studio. Ultimately, Digital Domain completed approximately seventy shots in fulfillment of its contract.

As shooting progressed on the show, after a rather long hiatus, *Red Planet*'s visual effects needs were reevaluated and, in many cases, drastically changed. The overall scope of the work remained continually in flux and, over time, grew dramatically. Jeffrey A. Okun, who had been involved in a number of Warner Brothers projects, was brought on as a consultant, and eventually became the film's visual effects supervisor.

Six weeks of shooting remained at the time Okun joined the production, which was headquartered in Australia. "My visual effects producer, Tom Boland, and I immediately sat down and did a new breakdown to rebudget the film's effects," remarked Okun. "At that point it looked like eight hundred shots, nearly three times what had been initially projected." The increase in the number of shots – which, in the course of postproduction, would balloon even further to 947 – mandated a new approach and prompted Okun to bring on no fewer than ten additional vendors. "Over the course of shooting, the scope of the effects work grew even more, and changed somewhat, ultimately requiring



After a six-month journey, the Mars 1 enters orbit over the red planet. Pixel Magic deep-space cuts ranged from wide establishing views to paint-scraping passes over the vessel's hull. The company employed digital multiple-pass techniques to create shadow and specular light effects, allowing for alteration of individual elements during the composite phase without the need to re-render in 3D.



Under the stewardship of visual effects supervisor Erik Nash, Digital Domain built a twenty-two-foot-long model of the Mars 1 spacecraft, and contributed a number of motion control shots. The Digital Domain ship – later

a larger and a slightly different mix of companies and supervisors. But after figuring out what was needed and who was going to do the work, we still had to wait around for a time before getting started,

embellished with additional paintwork detail by Grant McCune Design – served as the basis for Pixel Magic's digital representation.

because the director's cut didn't emerge until April, even though at that point we were still technically scheduled to release on June 16. Then the studio pushed back the release again – to November – and brought in editor Frank J. Urioste, who is, in my opinion, a genius. Working closely with editor Dallas Pruett, Frank recut the entire film, a process that ran well into August, leaving us with very little time to accomplish the visual effects, even for a November release."

Red Planet begins just prior to the launching of the Mars 1 spaceship, which departs from earth orbit. Digital Domain had completed a number of shots for the scene, using the twenty-two-foot motion control miniature that the model shop crew had built. That model, along with a Cosmos space probe model seen later in the movie, was subsequently transferred to Grant McCune Design, where supplemental paintwork was added to enhance contrast and bring out details on the vessel's surface. "Unfortunately, when the model was ready, we couldn't find a stage available that was configured to let us create the kinds of moves we wanted with a miniature this size," Jeff Okun recalled. "Right about that time, Pixel Magic – one of several companies doing animatics for us – built a test version of the ship in CG. That looked so good we wound up having them photograph the miniature for textures and do the bulk of those shots using a refined version of their digital model."

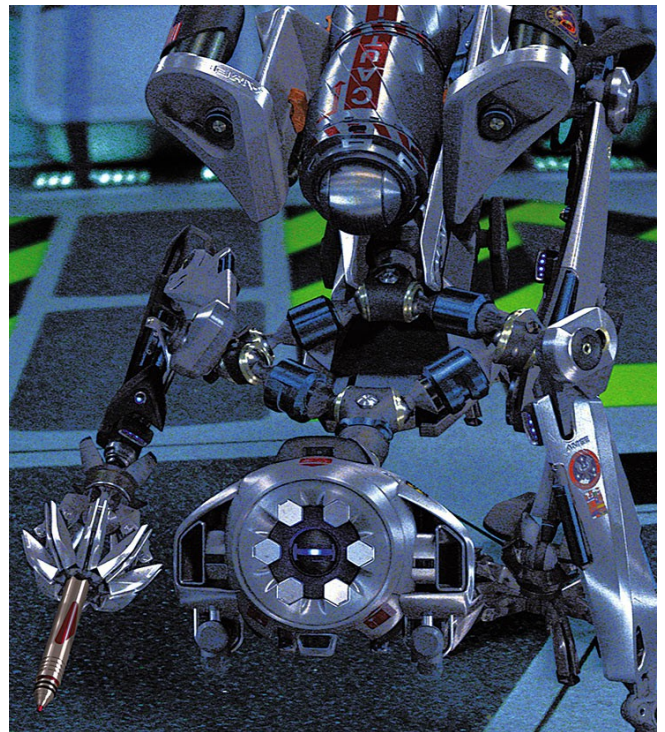
The resulting three dozen cuts included not only the Mars 1 shots, but also others meant to establish the orbital neighborhood from which the ship departs. Featured elements included a space shuttle, an expansive space station, workers and astronauts, and earth-prominent space backgrounds. At Pixel Magic, visual effects supervisor Ray McIntyre, Jr., and visual effects coordinator George Macri and their crew used Lightwave 3D for modeling, texturing, animation and rendering throughout, employing a variety of off-the-shelf plug-ins for lighting.

The first shot in the film has a space shuttle flying over camera in a manner reminiscent of the opening for *Star Wars*. "As it pulls away from camera," McIntyre related, "there's a tilt-down revealing the International Space Station, towards which the shuttle is headed. Our station model was designed to look about three times bigger than the real one is projected to be – its top level roughly represents where they are going with the first-generation station – the idea being that we'd depict fifty years' growth with two new layers of depth added to it. The modular construction concept employed on the real station was an idea we retained on our model, though for extremely close flybys we added some very different and complex detail on some of the station pods." This is most evident when the shuttle moves in to dock. "We go through a whole series of beauty cuts as the shuttle bay doors open to receive a docking tunnel extended from the station. This plays out with the earth visible beneath the station, concluding as a big clamp mechanism locks the tunnel to the shuttle, while exterior indicator lights go from red to green."

For earth backgrounds, McIntyre began by researching existing reference imagery. "We couldn't find anything high enough in resolution that gave us a sufficiently large image," McIntyre explained, "so we had to piece together many different views, and wound up with a 12K-by-10K image mapped onto a globe. We assembled the earth imagery in the comp phase, building up the atmosphere in

layers: a clean earth element, a cloud element, then a smog element for the at-this-point barely inhabitable planet, a layer of haze over that and then one more smog layer at the curve of the earth to give us a brownish rim.”

Multiple-pass techniques were also used for shots of the CG spacecraft. “We treated the various objects in the frame like elements in a motion control shoot,” observed McIntyre. “We used the alpha channel for object mattes, plus there were additional passes for the shadow matte, a diffuse light matte pass, specular light matte pass and depth matte pass, which allowed us to control the depth of field when we got really close to an object. Having those matte passes gave us the option of adjusting the shadows, lighter or deeper, much later in the process, without having to go back and render in 3D. Any changes could be made during the compositing phase.” Artists Patrick Murphy, Bruce Harris and Jim Gorman did the extensive compositing.



AMEE – a military robot reprogrammed as a ground navigation unit – is unveiled aboard ship. Though a few static shots used a practical posable representation of the robot the majority of the AMEE scenes featured a 3D model computer generated and animated by Cinesite.

The Mars 1 vessel is showcased in a lengthy tracking move that travels down the station. “The minute-plus opening shot had already shown the ship’s length to be nearly as great as the width of the station,” McIntyre related, “but seeing it up close contributed even more to the sense of enormous mass. From there we went on to do shots of the ship departing the station on thrusters, followed by a big shot inside the dark engine as it lights off and propels the ship toward Mars.”

The scenes set in space featured a relatively high key-to-fill ratio. “We went for a lot of contrast,” McIntyre elaborated, “but not to the degree you’d actually experience in space. Jeff Okun wanted a more cinematic look, so we took license with the fill so that more details on the various craft could be seen. The deep-space shots of the Mars 1 traveling between planets had the most extreme key-to-fill ratio. All of the earth-orbit scenes included a pronounced bluish fill to represent bounce light from earth. A much less substantial reddish fill was used for later shots near Mars.”

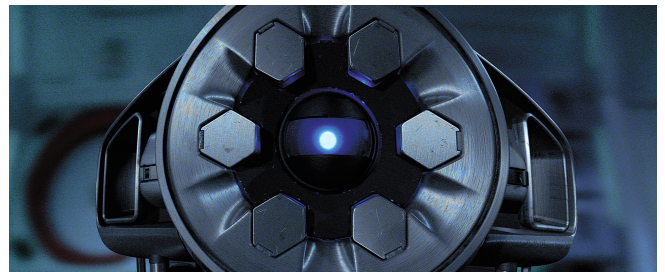
Shots of the ship in Mars orbit ranged from extreme beauty closeups to three-quarter views of the planet with the ship seen as a mere sliver against it. As with the earth backgrounds, Pixel Magic generated the views of Mars by mapping high-rez images onto a 3D globe. “A number of those shots were designed to utilize the terminator line that separates day from night on the planet,” McIntyre noted, “which afforded us the opportunity to play with the lighting in a dramatic fashion. Some of the cuts ran as long as eight hundred frames, so we could start in darkness, then slowly cross over with the ship into bright light with a graceful move.”

The most dramatic of the Pixel Magic ship shots starts with a close view of live-action people inside the window of the MEV. “The shot is a real camera-scraper,” said McIntyre, “pulling out from that window and back, traveling over three-quarters of the Mars 1 hull. We’re just three to five feet away from the ship for a good part of the shot. Obviously, there needed to be a ton of detail; so we had to come up with new texture maps – and the depth matte pass came into play, as well.” In addition to their all-CG space shots, Pixel Magic also scanned and composited four film elements of the Mars 1 miniature.

Aboard the ship, Gallagher unpacks and activates AMEE, the digital creation of which was assigned to Cinesite early in production. Scripted as a one-time military robot converted and reprogrammed



Upon activation, AMEE demonstrates her physical dexterity and capabilities for the crew. An advantage of the all-CG approach was that it allowed for a complex robot design that could in no way have been achieved with a performer in a suit.



A closeup on AMEE’s head reveals a widescreen eye. Robot POV shots – which replicated that widescreen look, with multiple video images and graphics – were also generated by Cinesite. Digital artists simulated a brushed-metal surface with texture maps that included nearly microscopic scratch marks. Shaders were used to create metallic highlights.

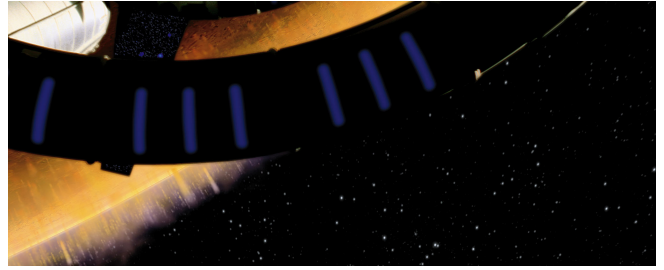
as a Mars surface navigation unit for employment on the manned space mission, AMEE would present the company with the opportunity to create a fully dimensional CG character. Cinesite's initial take on the concept for AMEE was quadrupedal, featuring a curvilinear head shaped rather like a taco. "That version of AMEE included little subsystem modules that were like the detachable sections on the Eagle spacecraft from Space: 1999," conceptualist John Hewitt remarked. From there, AMEE entered a kind of supermodel phase. "From certain angles she looked impossibly thin, almost frail, but she's really this weapon of immense strength and something to be afraid of. The difference between seeing her in profile and seeing her straight on created a strong disparity in how she was perceived; and this played right into the character's dichotomy."

AMEE became progressively more humanoid in appearance, and the design was finally locked when conceptual artist Ron Cobb was brought on specifically to illustrate the robot's head. "The painting Ron did was a shockingly huge digression from our original designs," Hewitt admitted, "but it did really lock her in for us." One thing missing from Cobb's painting, though, was AMEE's singular eye – which the artist had left blank. In a mere two days, Hewitt and modeler Jonathan Gerber whipped out a number of different eye concepts – one of which production bought off on right away. "It was anamorphic in shape and had a series of hexagonal forms arrayed around a blue eye. I liked the properties of the hexagonal shapes, which suggested the menace of a lamprey." The final robot design paired Cobb's head with a body that was conceived in the main by designer Simon Murton.

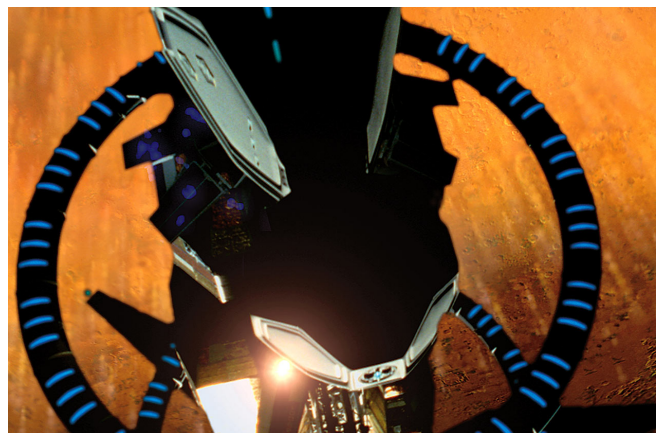
With studio approval of the AMEE design secured, it fell to Gerber to create a functional digital model. Working with technical director Scott Ballard, Gerber also helped with the robot's animation setup. "The character setup guys were very proud of her," recalled CG supervisor Serge Sretschinsky. "They went to the animation guys with the directive, 'Make her move however you want, and we'll give you a skeleton that will deliver.' AMEE could contort herself in ways no man in a suit would ever have been capable of doing, and was even able to turn herself inside out in a rather nonchalant fashion." Additional articulations included spars that telescoped in stages like a radio antenna, a head that could raise and lower, folding legs, a swiveling backpack and an outward-moving midsection.

Once activated, AMEE demonstrates her impressive physical dexterity, deploying fluidly and then revealing remarkably deft claw-eye coordination. Cinesite's CG animation, accomplished in Maya, showcased the model's ability to configure and reconfigure itself in an ultra-flexible manner. "Our animation tests of AMEE featured a whole range of actions that were executed by animator Christopher Lentz," recalled animation director Steve Markowski. "These gave production a better idea of how AMEE might behave, both in her more playful state and later on, when she shifts into military mode."

Initial shots of the digital AMEE within the Mars 1 interior – a set that utilized diffuse fluorescent strip lighting – presented the Cinesite crew with its most problematic lighting scenario. "There were no strong keys on the set," John Hewitt observed, "so, since RenderMan won't give you bounce-light effects, our lighters began by including all visible sources of light in the plate. It was especially challenging for them to make this well-illuminated room work with AMEE's brushed-metal surface. Reflections on such metal fuzz out a short distance away, leaving only a hot spot."



As the crew makes final preparations for its descent to the Mars surface, disaster erupts in the form of a solar flare. After generating CG animatics for the sequence, MetroLight Studios created the flare, which strikes and wraps around the planet, then sweeps over the orbiting Mars 1.

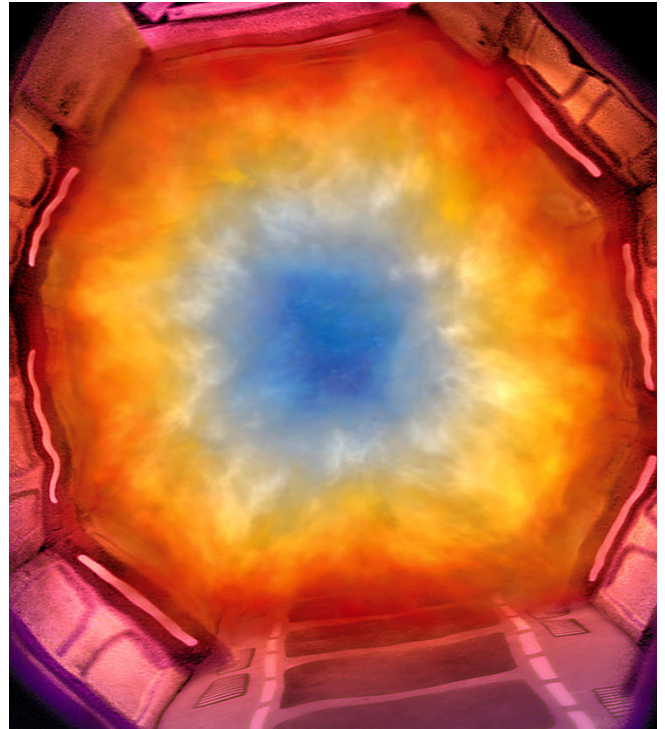


The phenomenon was combined with footage of the Digital Domain ship model. To suggest interaction between the solar flare and the two-dimensional plate photography, MetroLight utilized a 3D CG model of the spaceship as a virtual black-box miniature so that the flare would occlude along the vessel's actual contours.

The key to presenting digital AMEE in the best possible light lay in the discovery of an already existing lighting model. “I found a lighting model called the Ward model that was based on empirical research detailing how materials react to light,” Sretschinsky said. “It was very good at coming up with anisotropic surfaces, which reflect light more in one direction than another. Brushed metal, with its nearly microscopic scratches, has a surface like this, with highlights mostly following along the lines of these markings. The unique fall-off, as well as the specific shape of the highlight, was built into a shader; and we used a bump map to create larger striations.”

Though Cinesite’s digital creation would be most prominent in the film, production designer Owen Patterson had arranged to have a posable full-size AMEE built for use on set. The practical robot served the dual purpose of providing an adequate lighting reference for Cinesite’s CG animation and acting as a stand-in to which the live actors could relate during shooting. In addition, the final film would feature a handful of shots captured with the practical AMEE alone. “There are two cuts of her being loaded and unloaded aboard the Mars 1,” explained Jeff Okun, “one of which featured the robot in her storage chamber, which was built and photographed at Grant McCune Design as an insert. Then, at the end of the film, there are a couple of cuts of the practical as AMEE gets burned and blown to pieces.”

The crew is in final preparations for descent to the surface when disaster strikes in the form of a solar flare that ravages Mars and damages the ship. After generating flare animatics that were used as placeholders in the director’s cut of the film, MetroLight Studios was awarded the final sequence. “Although the flare scene was reconceptualized before we started on the finals,” recalled MetroLight CG supervisor Jerry Weil, “our early animatics helped us get a good idea of what was needed in the scene. For the flare itself, the general guidelines came from Hubble nebula imagery; but the overriding concern was that it look really cool. We see the flare both from within – where the nebula look is very pronounced – and from outside, which was something more in the vein of an aurora.” MetroLight utilized Maya and RenderMan software to create the flare’s devastating passage, which featured close interaction with the ship’s exterior and views of the flare’s energy wave tearing through the vessel interior. “There was a 3D spaceship model that we used as a kind of black-box miniature. That way our flare had something with which it could react. Then, in the ship interior plate imagery, we tried to impart a fiery look to the energy wave, with colored smoky textures that again were rather nebula-like in appearance – beautiful as well as deadly.”



For shots of the solar flare blasting through an interior corridor of the spacecraft, MetroLight combined its CG effect with a live-action plate filmed on the ship set. The colorful look was suggested by nebula imagery captured by a deep-space telescope.

Various onboard systems are damaged during the solar flare strike. While the other crew members hurriedly board the MEV lander, Bowman remains behind to launch the craft and fight the fires starting up everywhere. Smoke, flame and debris elements were created and composited at Hammerhead Productions, where the sixty-shot sequence was divided into thirds — intercut with the MEV's descent to Mars – and separate teams assigned to each of the major sections. “There’s a progression to the scene,” observed Hammerhead visual effects supervisor Jamie Dixon. “After the Mars 1 gravity module stops rotating, everything is shown floating around while Bowman attempts to put out the fires. The second section has her being chased by flames through the ship, while the third has her extinguishing the blaze by venting the ship’s air supply into space. The whole sequence was similar; so we were able to leverage off the same approaches throughout – which was fortunate given the lack of time available to do this volume of work.”

Many of Hammerhead’s contributions to the sequence were after-the-fact embellishments designed to plus-up the movie’s quotient of dangerous scenes. “The live-action had been shot before I came on, when the thought was that there wouldn’t be smoke and debris effects,” explained Okun. “That’s why there were practically no interactives on set, just a few spark-flashes. Everything was supposed to be filmed in-camera with the idea that, at worst, there’d be a need for wire removals. But when I saw the cut sequence, it was boring. The director had wanted to see drifting glass shards and smoke from the beginning, but had been told those effects would cost too much, so they were nixed. I suggested to Frank Urioste that we layer in smoke and glass debris, plus big plumes of zero-gravity fire to make things look exciting.”

The Hammerhead team began work on the scene by tracking every shot. “We decided up front to use our 3D tracking software throughout, so everyone here spent two weeks tracking the hell out of everything,” Dixon recalled. “There was a lot of shaking on the production camera shots, which helped to sell the reality of the environment, but only limited setup information was taken on set – the modern mode of filmmaking, I’m afraid. Fortunately, though, everything had been shot clean, so we always had a ton of details in frame to track. We were also provided with set plans.”

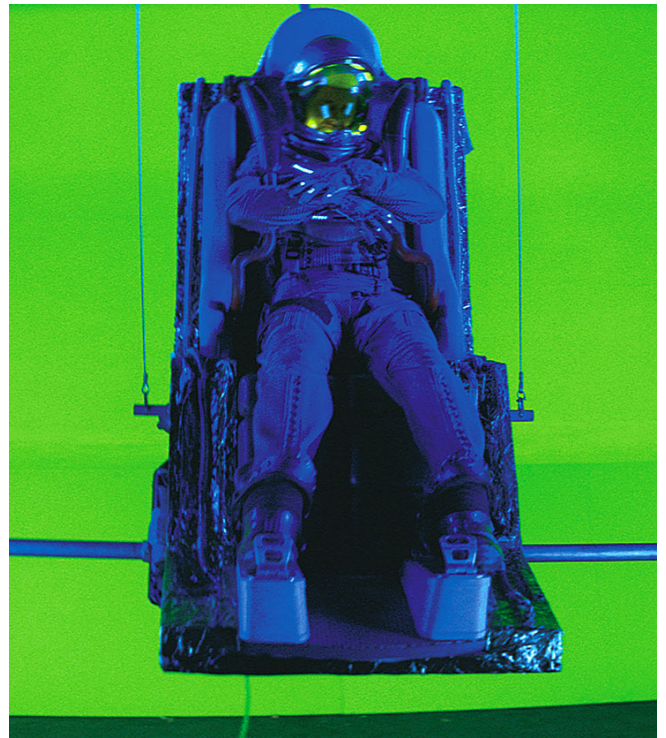
The live-action portion of the sequence had employed various techniques to suggest zero gravity. “Every kind of rig you can imagine was used,” Dixon declared. “They had Carrie-Anne Moss on wires, filmed with the camera inverted, and probably used teeterboards for some of the medium views; plus a number of cuts were shot against greenscreen. It was all mix-and-match; and the first time I saw the cut sequence it was difficult to tell what was supposed to be happening. But by the time Frank Urioste finished reworking the cut, everything was very clear in terms of how the action progressed – which made our job easier.”

The modest interactive effects shot on the set suffered from being captured under the constraints of earth gravity, limiting their effectiveness. “The spark elements, which we called ‘poppers,’ were basically squibs,” Dixon noted. “They would go off, and all the sparks would fly out, then drop – which didn’t do much to sell the idea of zero gravity. One reason the live-action turned out as successfully as it did was that the camera had been inverted a few times. But that didn’t help with the spark issue, since in those instances they just fell straight up. As it stood, the sparks were pretty clear giveaways in terms of orientation of up and down.” To counter the gravity-bound sparks, animator Constance Bracewell created similar-looking digital sparks that could be placed in any

orientation. “We tended to add our sparks in opposition to whichever direction the practicals had gone. Just adding that bit of misdirection was enough to keep audiences guessing and going with it. Our sparks also looked a bit more like fireworks. We decided to add a second spark event to each little trail – so there’d be a star-flame and smoke flash to make it all a bit more incendiary.”



After launching her crew towards the surface of the planet mission commander Kate Bowman (Carrie-Anne Moss) fights fires erupting aboard the Mars 1 as a result of the solar flare’s passage. Hammerhead Productions motion-tracked each shot in the sequence, then created digital smoke, flame and debris elements, researching how fire would appear in a zero-gravity environment, but taking dramatic license in the execution.



Bowman opens an airlock to evacuate the ship’s oxygen and choke off the flames, but the rapid decompression causes the seat into which she has belted herself to tear loose and hurtle toward the open port. Production simulated the intense action on stage by filming the spacesuited actress against greenscreen.

Since there was insufficient time to model the set's dimensions in the computer so that true interactive lighting from the sparks could be introduced, the Hammerhead team made use of image processing techniques to create flickering that tied the CG sparks into the plate from the set. Another method of furthering the integration of digital elements in the real-world set involved the company's particle system. "As the sequence goes on, there is an ever-increasing amount of smoke being introduced into the shipboard environment," Dixon observed. "That smoke element, while integral to conveying the drama and the danger, was even more important for us in order to convey a dimensional feeling in these rooms. Our setup for creating smoke is an evolutionary particle system that gets used on pretty much every film, either for atmospheric effects or to add a bit of density. Since it supports very sophisticated lighting approaches to allow greater interaction, we could trigger light and smoke events that corresponded to the sparks and flames going through frame – which helped further in compensating for the lack of interactives on set."



Hammerhead composited the greenscreen footage with background imagery of the set, plus massive doses of digital flame and debris.

Determining a look for the fires that flare up throughout the spaceship required a period of research. "Traditionally, fire is very tricky," Dixon related. "While it's common to shoot practical elements like naphthalene gas against black, we decided against that, largely because these flames were supposed to be in a zero-gravity environment. We looked at the result of NASA's small-scale experiments with zero-gravity fire, and the flames took on a look not unlike that of liquids forming into a spherical mass. Since that shape doesn't allow for convection to take place, no fresh oxygenated air gets drawn into the base of the flame – which in zero gravity, is at the center of this ball shape – and as a result, zero-gravity fires end up extinguishing themselves pretty quickly. But our sequence wouldn't be very interesting if the fire turned into a ball and went out. So, together with Jeff Okun, we figured out how production thought the fire should behave, which turned out to be something like terrestrial fire, with lots of little unidirectional flames shooting up. We retained that style of fire, but added a whole ring of these flames so they shot out in all directions."

Before proceeding any further, the Hammerhead team also reviewed *The Matrix* and *Backdraft*, as both of those films featured slow-motion flame shots. "We're so used to seeing fast-moving flames that it's easy to lose sight of fire's fundamental nature," Dixon said. "While our sequence was pretty fast-paced and didn't really lend itself to a beautiful, loving inspection of the flames, we still wanted to see some structure and texture, as well as something of fire's behavior." Blobby modeling was used to produce the general flame structure, and displacement mapping to create bumps that resembled fiery heads of cauliflower. Technical supervisor Thad Beier wrote custom shaders to provide the texture and suggest the proper luminosity. "That last aspect was quite important since, in dark surroundings, flames often become overexposed, whereas in a daylight situation, the textures are more visible. Since we had control over how our flame looked, we wound up splitting

the difference between the two extremes, creating something that read well and still had some of that blown-out feel.”

Bowman grabs a fire extinguisher and attempts to douse a small circuit-panel fire. Though the extinguisher was a practical prop, its flame-retardant emission was computer generated at Hammerhead. “We found out that the fire extinguishers on a spaceship will shoot a foamy, goopy stuff instead of the usual gas spray,” commented Dixon, “because the retardant material needs to be able to stick to all surfaces in a zero-gravity situation. So we modeled the foam after a kind of shaving cream that comes out clear, then fogs on contact.”

As Bowman flees the burgeoning flames, she makes her way through thousands of tiny debris shards – the result of fluorescent light panels blown out during the solar flare event – that are floating through the interior. The floating debris would be a key to simulating a weightless environment. “The glass debris was fairly easy to render,” explained Dixon, “since we just put a single very bright light on it to get the stuff to sparkle. The one other aspect involved interaction. We came up with a CG body shape to represent Carrie-Anne Moss and ran that along with the debris to get the pieces to bounce off, which created additional lighting kicks as the shards changed direction.”

In a desperate move, Bowman dons a spacesuit and secures herself, then opens the ship up to space, allowing the oxygen to vent in the explosive decompression and causing the fires to die out. Although her plan to quench the fire is successful, the commander is in imminent danger once again when the chair that she has secured herself to begins to break away. Bowman is sucked toward the hatch and open space, held back only by a thin cable to which she is tethered. Most of the shots in the depressurization sequence were achieved by combining greenscreen elements of the actress with background set plates. The tether was produced both practically on the set, and through digital means at Hammerhead.

While Bowman battles the blaze, the MEV descends toward a rough landing on the Martian surface. Okun called upon Frank Cappello of Fine Grain Films, whom he had met on Suburban Commando, to create animatics for the scene. A writer/director with several features to his credit, Cappello wound up producing, in addition to the animatics, a number of more elaborate temp shots that ultimately made up a sizeable portion of the movie’s trailer. “Visualizing the reentry and the crash was a lot of fun,” Cappello admitted, “because Jeff let me design aspects of the sequence. He knew he wanted the MEV’s giant airbags to deploy and that there would be a crash with it bouncing along the surface; but beyond that, he wanted something exciting that used big reveals and surprises. Just when you thought the MEV was going to stop tumbling down the hill, for example, it would instead plunge off a cliff.”



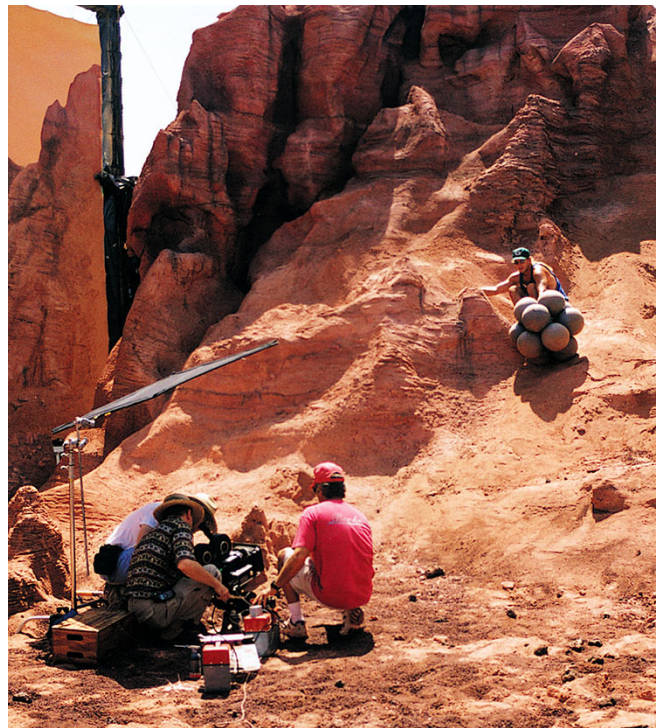
Parachutes deploy from the Mars Entry Vehicle to slow its descent. Fine Grain Films created a series of digital cuts depicting the passage of the MEV – from separation with the Mars 1 to just before its impact on the planet – enhancing photorealism by incorporating motion blur and lens flare effects.



Grant McCune Design fashioned a scaled terrain for the rough landing. Modelmaker Dwight Shook takes measurements from a small maquette that served as the basis for the scaled-up Martian landscape.



The modular design of the miniature set – backed by a painted cyclorama to extend its scope, enabled the same structure to be reconfigured and reused with MEV models ranging from 1/24-scale to quarter-scale.



Illusion Arts director of photography Bill Taylor prepares to shoot a sixteenth-scale MEV – with protective airbags deployed – as it tumbles down a Martian mountainside.

The animatic and trailer images incorporated more than the usual amount of detail, and contributed to Capello's eventually being engaged to create MEV descent finals for inclusion in the actual film. "My animatics were pretty high-rez to start with – I don't ever use unshaded stuff – so it wasn't that big a leap to refine them," Capello commented. "I had already put in some dust elements, added camera shake and motion blur, and rendered shadows. The reason I go to this much trouble is that I like animatics to convey what the final shot is about and how it is really going to look – that's the filmmaker in me. But I think this approach goes a long way toward helping editorial evaluate the effects cuts, as well."

Fine Grain finals for the film took the MEV from the start of its orbital reentry down through the atmosphere, ending just prior to impact. Starting with the reentry, and utilizing Light-Wave, Capello created a dynamic passage for the MEV. "Everyone's seen *Apollo 13* and *The Right Stuff*," Capello

observed, "so there's a collective concept in the minds of audiences about what reentry looks like, with the fire taking on a kind of liquid plasma quality. These views are usually pretty static, from one side of the capsule, looking up at a glow coming off the heat shield. To make things a bit more exciting visually, I designed a shot with the MEV coming toward camera and passing beneath, with the whole field of view then spinning around to follow the path of the capsule as it speeds down toward the planet – and the craft would be seen on fire all the way through, from a variety of different perspectives in a single shot."

Capello ventured outdoors to shoot freon and carbon dioxide reference imagery, which helped to accomplish the desired plasma fire look. "The problem was translating that look to read credibly in three dimensions throughout all the changing perspectives in this shot," Capello observed. "Mapping animation onto 2D planes in the computer never looks quite dimensional enough to me, so I wound up using all sorts of shaders to get the fire tricked out nicely."

In a later shot, drogue chutes unfurl to slow the downward-rocketing MEV as it rushes past camera. "There are a hundred chute lines, most of which are barely discernible," stated Capello, "which was in keeping with the NASA footage I reviewed. Sunlight often wraps around the lines and thins them to the point of invisibility – but that was okay because it helped with scale issues on the MEV." The chutes featured double-layered material with front flutes, into which Capello introduced rippling effects via displacement mapping. "You do find yourself wondering how much wind there would really be in the thinner Martian atmosphere, but it always comes back to whether you want to be scientifically accurate or faithful to what looks good on earth. The aerobraking sequence in 2010 used ballute forms that read like stop-motion when inflated; and while I think that staccato look resembled what would actually happen in space, it certainly didn't look right. An audience



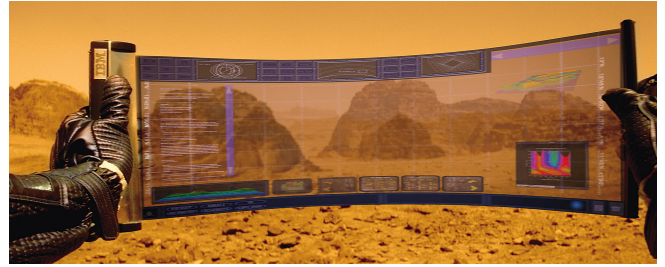
After the landing craft comes to rest the airbags deflate so that its occupants can exit.

perceives movie reality as something filtered through its own experiences – and we have to accept that and deal with it.”

The Fine Grain Films CG descent views wound up being intercut with shots using a practical MEV miniature, with the latter approach also being employed for nearly all of the cuts in the extended crash sequence that follows. The MEV crash was shot high-speed at Grant McCune Design as part of a series of sixty-seven shots accomplished during a three-week shoot. On hand for the shoot was Jeff Okun, along with Illusion Arts co-owner and matte cameraman Bill Taylor, who was brought on to photograph the sequence. Modelmakers at Grant McCune fabricated MEV miniatures in four different scales to match production’s full-scale module, which was shot on location. “The smallest of our models was used for airborne views of the MEV,” said miniature foreman Monty Shook. “Ray Moore, Scott Burton and I built it in twenty-fourth scale, using a rigid vacuform parasail chute. When it was photographed against greenscreen, the model was inverted to give the impression that the chute’s shroud lines were under tension.”

For shots of the spacecraft approaching and crashing down on the Martian surface, three larger-scale MEV models, manufactured in sixteenth-, twelfth- and quarter-scale, were required, along with like-scaled landscape miniatures. The larger MEVs also featured airbags, which were developed by Richard Slifka. A variety of urethane elastomer skins were applied over poly-foam cores to produce the spherical crash protectors. Twelfth-scale nylon skins were treated with muriatic acid to weaken them for shots of airbags being punctured during impact with the rocky Martian surface.

The Martian landscape – also set up at Grant McCune Design – featured a steeply sloped terrain, down which the careening MEV would travel before coming to a stop on the level ground below. Modelmakers contoured and engineered the construct, which measured twenty-six feet tall, thirty-five feet wide and fifty feet deep. Ingeniously, the Marscape was fashioned as a variable-scale structure – through redressing, the single model was used with all four scales of MEV. “A variety of scaled soil and ground textures were created by using an assortment of volcanic gravel, augmented with an overlay of ground clay dust and strategic placement of larger volcanic stones,” explained Shook. “Behind our terrain model was a twenty-foot-tall, forty-foot-wide backing painted by veteran visual effects artist Clark Schaffer, who worked from a small design by Mike Wassel, created at



Finding no evidence of the oxygen-producing algae that is ostensibly terraforming the red planet the stranded astronauts go in search of an abandoned Russian lander they hope will afford them a means to return to the Mars 1. To aid them in their journey across the alien landscape, they use hand-held computer units with flexible display screens. Flash Film Works created graphics displays for the practical props used on set. Four-point tracking was needed to marry the graphics – which bent and twisted as the units were handled – to the live plate photography.



Flash Film Works also created the graphic displays seen on board the Mars 1, including an elaborate multi-screen panel employed by Bowman to monitor the status of her ground crew. 3D animation provided representations of severe storm activity on the Martian surface.

Illusion Arts.” Illusion Arts also tackled a wide view of the crash, featuring a digital MEV caroming downhill through a scenic Fumi Mashimo digital matte painting.

Post-crash inserts showing a Mars 1 crewmember – in actuality, Grant McCune Design staffer Diane Ault – disembarking onto the planet’s surface required construction of a full-scale surface set. Working from a twenty-fourth-scale maquette built by Dwight Shook, the McCune team built a series of modular units utilizing wood-frame construction. Those were hoisted into place, then covered with burlap and chicken-wire skins, over which concrete gunite was sprayed. Creation of the final surface details was another team effort, with master sculptor Marcello Petrocelli working in concert with Monty Shook, April Lanza and Scott Burton.

After the astronauts exit the MEV and depart on foot, AMEE – ejected with the landing gear and presumed to be scrap metal following the crash – stirs to action, kicking open a door and emerging onto the Martian surface. Though the robot has survived the impact, it has sustained damage – cosmetic changes that were applied to the Cinesite digital model. “Brian Gardner, our senior technical director, developed a shader that incorporated surface qualities for everything from deep scratches and gouges to a frozen AMEE for an ice storm sequence later in the movie,” related Tom Smith. “There were approximately eleven different levels of texture available.”

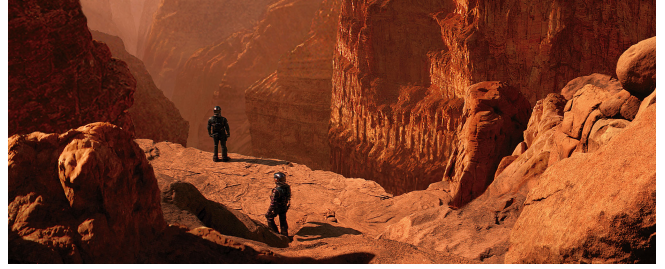
“We added more and more texture maps to AMEE to dirty her up,” affirmed Serge Sretschinsky. “The burn marks she sports after the crash created a nice sense of interplay between her damaged and undamaged surfaces. As she turns and displays her burned side, it’s almost as if she is revealing something darker in her personality.”

The robot’s deployment from the MEV takes her out onto the planet’s rocky and uneven surface – a far cry from the easily tracked spaceship deck on which she was introduced earlier. A tracking crew from Cinesite had been on location to gather pertinent tracking information, but time was often too short for production to stop and wait for the gathering of such data. “Fortunately,” said Sretschinsky, “we have a really good tracking department that can do a lot with minimal information. Jeff Baksinski headed up that effort, using in-house tools for 2D tracking and Equalizer for 3D work. With steady information fed into Equalizer, we could reconstruct the camera.” Based on data derived from the plates, CG ground planes – upon which AMEE would be animated – were then generated.

Housed within AMEE’s torso is a drone – essentially a flying eye – which the robot dispatches on a reconnaissance mission to search out the astronauts. “Jonathan Gerber came up with a number of drone designs,” recalled Smith. “Those evolved into the final concept of a lightweight and practical flying camera with two separate lenses and rotor blades that deployed from a rolled-up storage position.”

AMEE’s exploration and the drone’s search reveal a Martian landscape that was achieved by combining unusual locations and aesthetic enhancements applied in postproduction. While location photography shot in Jordan and in the Australian Outback suggested a certain rugged wilderness, the red planet’s distinctive coloration required scenic augmentation. “Early on, director of photography Peter Suschitzky had devised a great way to create Mars in-camera with filters,” said Jeff Okun, “but that approach got shot down, so everything wound up being filmed with only

minimal filtration. That meant we had to transform the yellow sands and blue skies of earth into something more appropriate for Mars during post.”



With prospects of survival dwindling, crew members Chip Pettengill (Simon Baker) and Ted Santen (Benjamin Bratt) come upon a cliff. To provide an expansive view of the terrain, Illusion Arts extended a small live-action area via a series of digital matte paintings, animating each separately to replicate the perspective shift of an on-set camera boom-up.

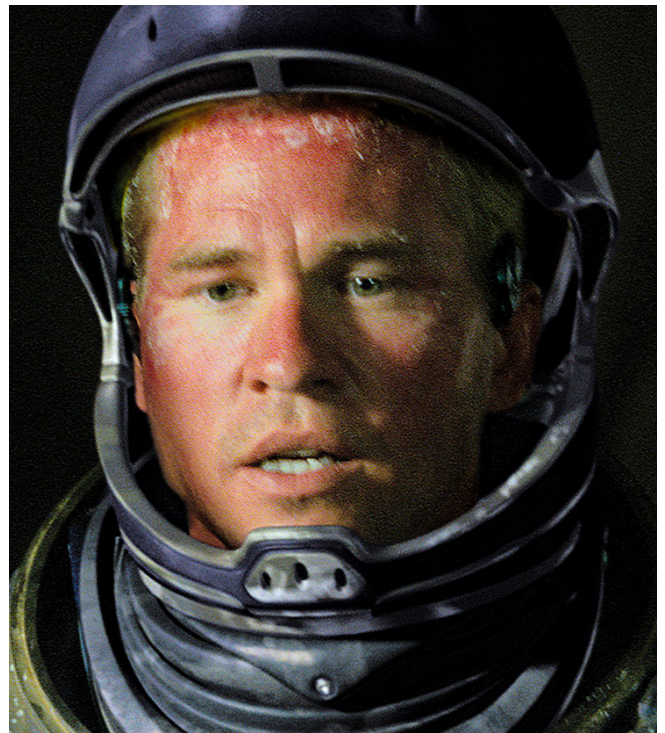


A struggle between the two men ends with Santen falling to his death. In addition to extending the live-action plate, the Illusion Arts team composited greenscreen elements of the astronauts into painted backgrounds.

While Okun had initiated Mars-look testing at several facilities, Digital FilmWorks would take up the mantle after production wrapped. “Digital FilmWorks locked into something that looked good and was affordable for the 350-plus shots,” Okun said, “but it was a tremendous amount of work, as there was no way to address the various elements globally and just dial Mars values in. Layers of mattes and roto-work were required, and each type of scene object had its own set of color-correction variables involved, which was very complicated. The spacesuits had to be pulled and rotoed out from the skies and grounds, and the highlights on the suits had to be separated out. Then the grounds were separated from the skies and shadows were separated from the grounds. Faceplates were separated out differently, as well.”

At Digital FilmWorks, the process of transforming the earth locations into Marscapes started with a lengthy testing period that began in February. “The filtration used by production was only enough to slightly affect the image,” observed DFW vice president and visual effects supervisor Cosmas Paul Bolger, Jr. “So it just didn’t go far enough into a fully red coloration. We pushed it further in that direction, while keeping in mind the directive from production that the look had to be something that would not hurt the eyes of audience members – after all, they were going to be seeing this for fifty minutes of the movie. So our Mars-look processes, though they required a large number of steps, were directed toward producing a pretty mild and restrained look throughout.”

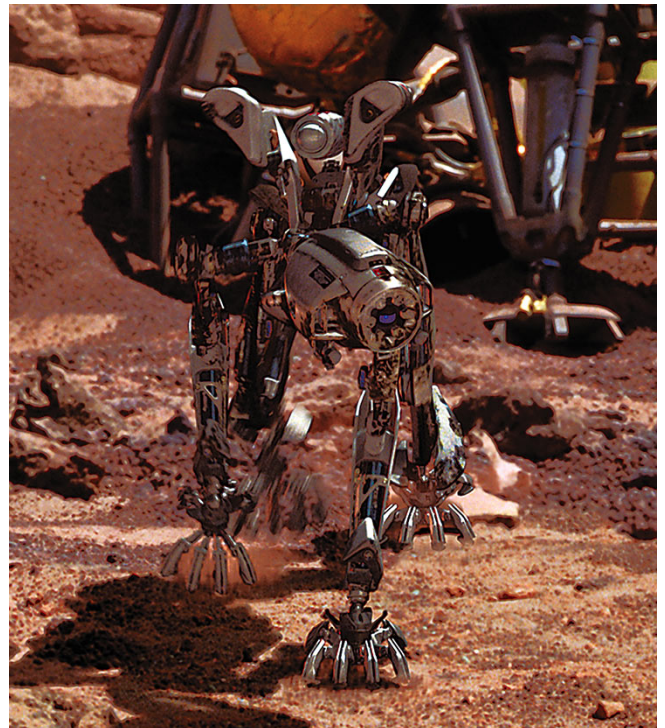
Digital FilmWorks received a final buy-off and go-ahead on their Mars look by July, then proceeded to tackle the hundreds of shots requiring transformation. Senior effects compositor Marco Paolini was responsible for a lot of the final look, which often involved adding or removing clouds, as well as changing image contrast levels. DFW also wound up performing all the scanning and laser recording for its own sequences – which constituted



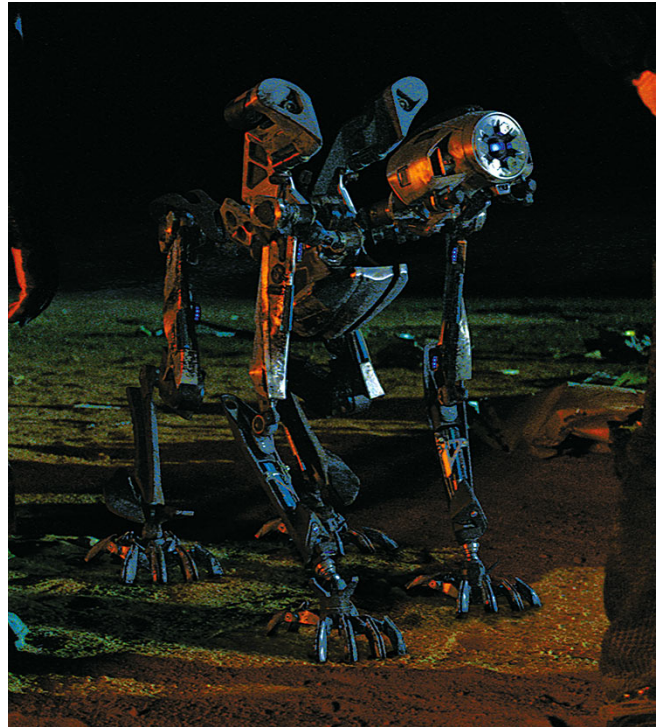
more than half of the total footage requiring such work – with EFILM providing a similar service for most of the other facilities involved on the show.

The astronauts set out in search of a habitat unit previously sent to Mars, which will provide them with food and air. To aid them in their journey, they employ handheld computer units that, through various displayed graphics, track their location and provide them with other technical data. Flash Film Works created the displayed graphics. “The computer props differed from modern laptops rather significantly, using display screens that were not only customizable in size, but flexible in structure,” noted Flash Film owner and visual effects co-supervisor William Mesa. “The units had handles that allowed the astronauts to pull the screen out like a curtain shade to any desired size. But the most interesting aspect was that these screens would only become rigid when fully extended; the rest of the time, they flexed like a thin piece of aluminum, so the images we were adding to them in post had to bend and warp and twist as the astronauts carried them. To get our imagery to conform, we needed to perform four-point tracking throughout, which required a software assist from Digital Fusion. Then animation supervisor Ken Stranahan worked out various aspects to get our imagery onto the flexible displays while including the proper reflections of the environment.” Two different types of handheld computer were utilized during shooting, the smaller one serving as a medical diagnostic unit, for which Flash Film technical supervisor Dan Fiovy generated numerous x-ray, thermal and ultrasound graphics.

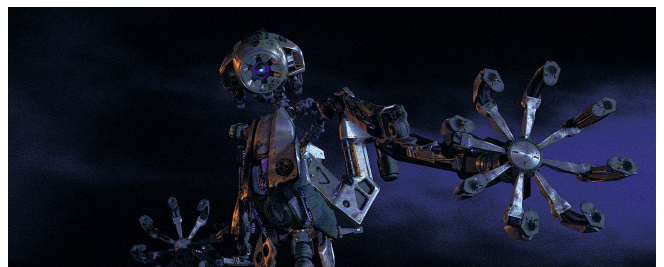
With his oxygen supply exhausted, ship’s engineer Robby Gallagher (Val Kilmer) opens his helmet visor to what he presumes to be Mars’ inhospitable atmosphere and certain death – but instead breathes in oxygenated air. The automatic visor purge and full helmet retraction were achieved digitally by Rising Sun Pictures.



Presumed lost in the crash, AMEE emerges intact from the MEV landing gear assembly, which was jettisoned during the reentry. Without benefit of on-set topographical data, Cinesite performed complex 2D and 3D tracking to align their CG character to the live-action plate photography, and created uneven ground planes for it to walk upon.



Having reverted to military combat mode, the now-lethal AMEE confronts the surviving astronauts. For scenes taking place after the crash, Cinesite developed shaders to impart gouges and scratch marks on the robot's metallic surfaces.



Animators also modified AMEE's post-crash behavior, giving her a limp and more predatory moves. Though she is quadrupedal throughout most of the movie, animators had the robot stand upright during an attack on the crew to convey a greater sense of menace.

Radio contact between the crash survivors and Bowman in the orbiting mothership is maintained throughout most of the film, with the latter using a large virtual viewscreen to review ground transmissions and perform status checks on ship systems. The viewscreen was also generated by Flash Film Works. "There were a number of virtual controls at one side that let Bowman manipulate the display," noted Mesa, "which was supposed to be capable of putting up multiple overlapping technical information screens simultaneously. We also produced a rotating circular dial control with a lot of calibrations on it. The idea was that this tool would allow the images to be moved around and zoomed on. In the plates, Carrie-Anne Moss just did a pantomime with her fingers, so we had to come up with CG controls that corresponded in space to her actions and still seemed like they could function as controls on the display." Flash Film wound up employing 3D animation to create views of atmospheric disturbances on Mars, as seen from the orbiting ship's cameras, while co-supervisor John Mesa generated and composited a variety of display graphics for burn-ins on the vessel's more conventional TV-style monitors.

Hopes for a Martian sanctuary are dashed when the survivors reach the habitat and discover it has been destroyed – though by what remains unknown. With their air supplies dwindling, the astronauts believe they have only minutes left to live. Pet-tengill and Santen, who have feuded throughout the voyage, wander off to a cliff overlooking an enormous ravine. Location footage of the actors required considerable digital enhancement, both to add rock formations extending into the distance and to establish the depth of the drop-off yawning before them. Illusion Arts supplied a series of digital matte paintings to complement the location work. The first shot in the sequence had been accomplished with a camera boom-up, so the matte elements had to reflect this changing perspective. "We divided the matte painting up into twelve separate elements," recalled Illusion Arts head matte artist and co-owner Syd Dutton. "Each of these elements was on its own plane, at a specific distance from the camera, so the amount of perspective shift differed for each, with the foreground matte-painted rocks put in on either side of the astronauts demonstrating the most change during the move. We had a series of rock formations receding in



A Martian ice storm freezes AMEE in her tracks. Cinesite modelers produced a complete digital terrain for the sequence, then created a particle system snowstorm.



Jeff Okun and Cinesite visual effects supervisor Tom Smith review shots of AMEE on the Martian landscape.

the distance on the far side of this great abyss; and those elements, since they were practically at infinity, demonstrated the least shift during the move.”

The two men begin grappling with one another; and in the struggle, Santen slips and topples off the cliff, plunging to his death far below. Illusion Arts produced a matte painting that depicted a down-view of the fall. “Because we wanted to really capture all the unique characteristics of the way light played off the terrain from this extreme angle, I had modelmaker Lynn Ledgerwood build a good-sized miniature of the cliff face,” said Dutton. “After photographing it, I used that image as a reference for my digital painting, which was done in collaboration with matte artist Kelvin McIlwain.” Illusion Arts also wound up compositing a variety of live-action closeup and medium shots of the fighting spacemen that had been filmed against green, adding them into their matte-painted backgrounds.

A number of other shots of the battling astronauts had been captured on location, but these had been done with the actors wearing visorless helmets – presumably to avoid picking up unwanted reflections of equipment and film crew members in the tinted surfaces. To add the visors and appropriate reflection elements, the production turned to Rising Sun Pictures. “During the fight sequence, most of the shots employed a handheld camera, with lots of extreme, violent moves,” noted Rising Sun digital effects producer Tony Clark. “Production had put tracking marks on the helmets, but these shots had so much radical motion that most marks only registered as a blur on the screen. As a result, there was nothing for automated tracking to grab onto; so it became a by-hand tracking process for David Short and Jason Madigan, who also did the rotoscope work and animated our CG replacement visors in Softimage.”

For the reflection imagery, Rising Sun mapped reverse-angle views onto the visors – a task complicated somewhat by the fact that final enhanced Martian landscapes had yet to be completed. “That required a bit of imagination on our parts,” Clark acknowledged, “since in creating an environment map, we had to figure out what the Martian surroundings would look like, including the color of sky and position of sun. We ducked back into



When Pettengill – who has been stalked and killed by AMEE – is discovered, his body is being consumed by a swarm of extraterrestrial insects called nematodes. Rhythm & Hues created the bugs digitally. Absence of 3D data from the live-action plate shoot complicated realistic interaction in shots of the nematodes roaming across and poking through the dead astronaut's face. To firmly plant the CG insects onto the character, Rhythm & Hues artists modified an existing cyberscan of Arnold Schwarzenegger to a rough approximation of Simon Baker's physiognomy, then projected the plate imagery onto that geometry, altering it a bit to optimize the fit. The result was a suitable facial landscape upon which the CG bugs could be tracked.



One visual aspect of the insects was their transparent bodies which, after eating, would glow the color of whatever had been consumed.

some early Mars-look tests we had done, to recheck Jeff Okun's palette for the sky and landscape. Ultimately, most of the look in the visor work came out of the compositing phase, which was set up by digital effects supervisor Didier Elzinga. We rendered separate layers of imagery for the visor that included the reflection, followed by a transparency layer, and another pass that gave us surface normals for the visor material. That layer showed us what angle the camera was to the material on any given frame, which was important for what part of the environment would be reflected." The Rising Sun visor composites, including visor matte shapes, were subsequently passed on to Digital FilmWorks, which added its graded Mars look to the sky visible behind the astronauts.

After Pettengill announces Santen's death – as a suicide – Gallagher's air supply runs out, and he opens his visor in what he knows to be a futile attempt to draw a breath. Ostensibly, the helmets worn by the astronauts had visors that could collapse down and retract into their spacesuit collars. Rising Sun would animate that action – dubbed Visor purge' – in 3D. "The details of our CG helmet were based upon the actual physical one supplied by production," recalled Clark. "Our lead animator, Ben Paschke, did additional modeling and texturing work that took those specifics into account, then added them to the digital helmet model that was supplied to us. Animator Wayne Lewis wound up animating two shots featuring the full helmet rollbacks; so those, in particular, revealed a lot of the detail that came out of Ben's work. The biggest complication was the need to match our CG helmet precisely with – and form into – the live-action costume, which was never static in the frame. Either Val Kilmer or the camera was always in motion, though never going through the kind of extreme actions that we had to deal with during the fight on the cliff."

Gallagher's desperate attempt to breathe the presumably inhospitable Martian atmosphere leads to the startling discovery that oxygen does exist on the planet, and at levels approaching those necessary for human survival. While the reason for this change in the atmosphere is not immediately clear, Gallagher, Burchenal and Pettengill are happy to be able to continue their journey across the surface, sans helmets. Their only hope for salvation – still dozens of kilometers in the distance – lies with an ancient unmanned Russian space probe, the Cosmos, which decades earlier failed to lift off from the planet.

The astronauts later encounter a run-amuck AMEE who, having reverted to military mode, is now intent upon disabling the men, whom she perceives as the enemy. At Cinesite, lead animator Derrick Carlin modified AMEE's walk cycle to include a limping action for her later scenes, suggesting damage resulting from the spaceship crash. The animators also gave the malfunctioning robot more predatory moves as the story – and her intent to kill – progresses. "Once she goes into military mode," Steve Markowski observed, "AMEE becomes more cat-like. Her head, which has been held up like a dog sniffing the air, comes down and she takes on a predatory persona. Later, when she chases Burchenal prior to getting on top of him, AMEE stays low to the ground, with legs set wide apart. At that point, her actions are modeled along the lines of a crocodile."

AMEE exercises her considerable agility while striking out at the astronauts, even demonstrating a penchant for martial arts – a specific capability the studio had asked Cinesite to showcase. "AMEE goes from being your best-friend robot to your worst-nightmare enemy," remarked Tom Smith, "all within the blink of an eye." The studio requested that AMEE remain down on all fours, but her one-sided battle with Burchenal provided an opportunity for the animators to demonstrate the menace of an elevated position for the robot. "I guess the concern was that AMEE never appear too human,"

revealed Markowski, “but once we had her up on two legs, there was the opportunity for AMEE to perform more rotational actions, so she could reverse direction by simply raising up and flopping over backwards. Plus, just having her up there looking down at Burchenal conveyed considerable menace.” The animators timed the robot’s actions, conforming their work to Tom Sizemore’s actions. “If Tom flinched, we’d use that as an opportunity to add a move from AMEE, such as her grabbing at his spacesuit collar.”

After teaching the humans a lesson in dominance, the robot leaves them to figuratively lick their wounds. “There was a lot of discussion about what’s supposed to be going on in AMEE’s brain at this point,” Markowski recalled, “namely, why doesn’t she kill them right away? This was something we really needed to justify, since it would be a pretty short movie otherwise – she’d just kill them all and that would be that.”

The answer lay with the robot’s post-crash reversion to military combat mode. “It was decided that AMEE’s whole strategy was based on certain tenets of warfare,” Smith acknowledged. “Instead of killing an opponent outright, which she was clearly capable of doing, AMEE instead cripples one of the enemy, which slows the whole unit down since they have to take care of the wounded man. After her strike, she lags behind, performing a kind of psychological war-op on the astronauts by tormenting them with the knowledge that she can reapproach and attack at any time.”

Later in the Martian night, an ice storm blankets the planet, freezing AMEE in her tracks. Project lead James Peterson oversaw the digital weather efforts, which included the creation of a complete CG terrain – augmented by particle system blowing snow – for several shots. Interaction between objects in the scene and these atmospheric elements required considerable care, along with no small amount of trickery. “The bits blowing across frame were supposed to be hitting the robot,” said Serge Sretschinsky, “but we found that it was better to just have AMEE emit the interacting snow – a cheat that worked just fine. Then, in order to convey a densely detailed impression of ice appearing on her metal skin, we did shader work for new texture maps. The darkness of these scenes helped out a lot, providing a justification for making things look contrasty, which was always a benefit when dealing with AMEE.”

The three surviving astronauts, having taken cover in a snow cave to wait out the freezing storm, discuss the fact that their intended escape vessel can carry only two men. Gallagher and Burchenal later awaken to find Pettengill gone, having taken the radio with him. They set out in pursuit, and soon find their quarry dead – slain by AMEE – his body covered with a swarm of omnivorous insects. The extraterrestrial bugs – called nematodes – have been feasting on algae and other materials sent from earth, then excreting oxygen at a prodigious rate, which accounts for the altered Martian atmosphere.

The endless green fields of algae were digitally generated at Rhythm & Hues, which was also responsible for the nematodes, realized via CG. “We wound up providing a really heavy-duty set extension for the algae field shots,” R&H visual effects supervisor Bryan Hirota recalled. “There were only so many lighting units available on location, so they wanted us to extend the terrain far beyond what their ability had been to light, thus creating a much grander vista. The other aspect involved adding the greener-than-green algae fields, though originally production had hoped to get a lot of the algae done in-camera. With that in mind, some practical algae had been made up and

filmed on set. Even though everyone thought it looked terrible, the stuff stayed in for a long time, until finally there was a consensus to replace it – and then it fell to us.” Rhythm & Hues painted the production algae out of numerous shots, then began the work of reconstructing the terrain contours, an effort that proceeded with little in the way of location or camera data, but was aided by matchmover Robbie Caplone. “Robbie used to be a camera operator, so he had a very good eye for lenses. Since we knew the types of lenses production had carried, he was able to make intelligent guesses about what lens was on the camera for any given shot.”

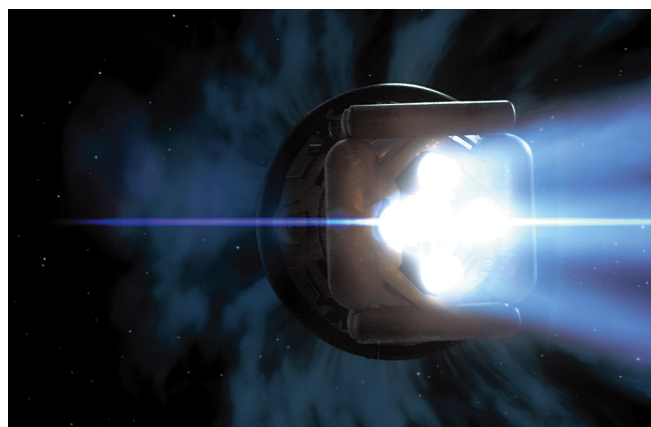
For many of the wider views, set extensions were addressed in 2D through digital matte paintings created by artist Michele Moen. “Michele created a series of dramatic horizons,” stated 2D supervisor Harry Lam. “We cheated the perspective on those to make them work even better with the limited arc of landscape in the plate images. For the distant 2D algae, we ran a separate highlight pass most of the time, which allowed the compositors to dial in contrast and brightness as needed on a shot-by-shot basis.”

Moen’s work served as a color and texture reference for all of R&H’s algae shots. Consistency was critical, since more distant 2D shots would be intercut with closeups of the algae that were generated in 3D. Effects technical director Tomas Rosenfeldt came up with an approach for creating the 3D algae utilizing L-systems – a methodology employed by Digital Domain for the ‘Autumn Tree’ sequence in *What Dreams May Come* – that permitted the organic forms to be ‘grown’ in tree-like branching patterns. The L-system technique was augmented by a particle system approach that allowed empty areas of the frame to be art-directed with supplementary bits of algae.

The algae fields prove to be a big draw for the nematodes, which become a source of danger for the astronauts. The nematodes – roach-like insectival forms with some crustacean-style attributes – evolved from a charcoal drawing done by Patrick Tatopoulos, which served as a jumping-off point for the digital realization of the bugs at Rhythm & Hues. “There was a bit of back-and-forth with production to work out a final look,” said Hirota. “Form follows function, so to some degree the design suggested



Gallagher, the last living member of the Mars landing team, locates the Russian spacecraft that he hopes will be able to lift him into orbit but is thwarted both by its nonfunctioning ignition system and by the sudden appearance of the murderous AMEE. Managing to disable the robot he hastily extracts her power pack and uses it to activate the Cosmos.



A quarter-scale Cosmos model – shot high-speed both with and without motion control – provided views of the launch. Digital FilmWorks contributed animated

how the bugs would move and act. They don't have eyes in their heads, and instead use their claws in a specific fashion to sense the environment – a point that Jeff Okun was very particular about.”

enhancements to the liftoff shots, and also built and animated a CG version of the craft for later shots in the sequence. In a daring attempt to rendezvous with Gallagher and the Cosmos, Bowman attaches herself to a tether aboard the Mars 1, then blasts herself toward the passing Russian vessel. The shot, realized by Digital Domain, featured a live-action foreground element, greenscreen footage of wire-rigged Carrie-Anne Moss, and a computer generated cable and starfield.

Nematode supervisor Dottie Starling rode herd on the modeling and animation effort, which made use of both Maya and Houdini programs. Only a few walk cycles were created for the insects, inasmuch as their single-minded pursuit of food suggested an implacable and largely unvarying walking motion. “The animators were usually able to take one of our base walk cycles and adapt it with slight modifications to conform to various environments,” Starling related, “such as when the nematodes burrow in and out of algae.” Since the creatures’ bodies are transparent, after ingesting food, their internal organs become visible, glowing the color of what they have consumed – usually green algae. Though the Rhythm & Hues crew explored achieving the glow in the renders, the large number of cuts precluded that time-consuming solution, and the glow was ultimately produced as a 2D effect.

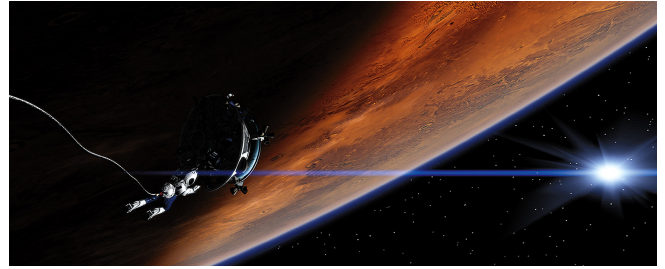
While some wider views of the bugs could employ mapping tricks to imply the degree of interaction taking place as nematodes swarmed through the algae, a credible simulation of the interaction in closer views was accomplished through a more elaborate approach, with Houdini – augmented by a number of compositing gags – used to animate the creatures. “Mainly it was about getting the bugs placed on contoured paths that conformed to the terrain,” Rosenfeldt stated. “With that done, we could feed in the bug animation, along with their location, and these pathways would define the directions in which our trees of algae got pushed.”

Shots showing large numbers of nematodes moving through the algae were accomplished at Rhythm & Hues through the application of a flocking program. “Within the group, we still wanted to retain all the characteristics of the individual creatures,” observed technical director Michael La Fave, “such as a random wriggle as they moved along their paths. Another key aspect involved establishing curving and irregular pathways for the flocking action. The accelerations and decelerations of the nematodes as they wend their way through the gaps and branches of the algae helped integrate their performance into the environment.”

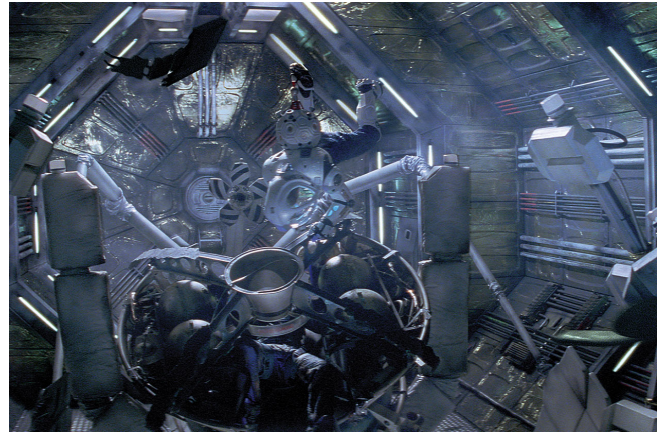
Establishing interaction among the bugs for views of them roaming across and poking through the dead Pettengill’s face was a slightly more complicated affair, made so by the absence of 3D data for the plate. “Production did provide us with scans of the spacesuits,” Hirota acknowledged, “but in order to come up with a face surface for the nematodes to crawl around on, we wound up using an existing cyberscan of Arnold Schwarzenegger. After pulling the cheekbones and other points into a rough approximation of Simon Baker’s face, we projected the plate imagery onto the Arnold geometry, and used Elastic Reality to tuck it all together.”

The two remaining astronauts begin making their way back to the Cosmos, but find their path blocked by hordes of the ravenous insects. When Burchenal discovers that the nematodes have penetrated his suit and are swarming over him – in shots that intermingled flocked nematodes with hero computer animation of the bugs – the scientist orders Gallagher to stand clear, then drops a torch onto the oxygen-filled creatures, creating an enormous explosion. Though it contained some

practical flame elements, the explosion was achieved principally through digital means. The fire effect moved across the surface of the image, appearing to char the ground as particles emerged from the leading edge of the blast.



Artists at Digital Domain created a fully CG Bowman and Cosmos for distant shots of the commander's attempt to snare the craft and prevent it and its lone occupant from continuing out into space.



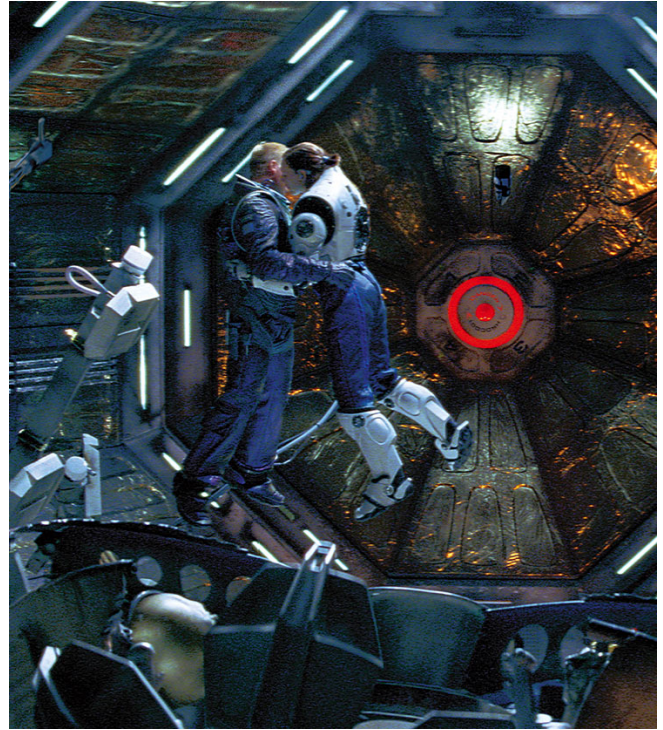
With the Cosmos safely in tow, Bowman reels herself back on board the Mars 1. To simulate the rough landing, production flew both a full-size Cosmos and stunt people on wire rigs, slamming them hard into the set. Flash Film Works handled wire removals for the sequence, and added digital smoke and floating debris caused by the impact.

Burchenal's self-sacrifice allows Gallagher to make it to the Cosmos, which he readies for launch. But the fates still work against him, as the probe's long-dead battery inhibits engine function. Even as Gallagher tries to make peace with the fact that he has exhausted his options and will die on Mars, AMEE decides to end her game of cat-and-mouse by at last killing him. But Gallagher turns the tables on the robot, pouring fuel into the parachute compartment of the Cosmos, which he then ignites. The parachutes blast out, knocking AMEE off her feet and entangling her in the burning chute cords. A mixture of digital and practical AMEE shots comprised the sequence. "We had to match AMEE into the live-action plates where pyro and debris were being blown around and there was interactive firelight," Tom Smith revealed. While at first it appears that AMEE has been burned to a crisp, like most unstoppable movie maniacs and robots she is not yet ready to give up the ghost. As Gallagher struggles to pull free her battery – a power source that will enable the spaceship to lift off – AMEE recalls her airborne drone and commences a countdown to self-destruct. The scene concludes with a shot of the practical AMEE on the ground as a computer generated drone descends toward her at full speed, exploding on impact. "The drone reentry and crash had to be hooked up with a practical explosion, so we added some flash frames at the end of our cut to make for a smooth transition." Production special effects supervisor Tad Pride provided the requisite full-scale fire and explosion effects for both phases of the robot's demise.

Able to power up the Cosmos with AMEE's battery, Gallagher lifts off. As with the MEV crash, Jeff Okun and Bill Taylor shot the liftoff sequence high-speed and without motion control at Grant McCune Design. The pair also shot inserts of the engine ignition against greenscreen, compositing the elements with a Digital FilmWorks Mars background.

The force of the liftoff takes a toll on the ancient Mars probe. McCune crew members rigged a quarter-scale Cosmos model with breakaway ablative surfaces – a task engineered by Rick Won and Jack Edjourian – to simulate the heat shield disintegration. Digital FilmWorks provided animation enhancements for this and other signs of the Cosmos' ever-declining state of flightworthiness. "After the heat shield starts to go, other parts of the module begin to come apart," Paul Bolger explained. "At one point a door even comes off of this old Russian probe. We built some CG elements and comped them in over the McCune model." As the probe reaches space, several more cuts wound up being handled by the Digital FilmWorks crew, which built and animated a 3D Cosmos.

Aboard the Mars 1, Bowman attaches herself to a tether, and blasts herself toward the passing Cosmos in an effort to latch onto it before it continues on out into space. Flash Film Works handled



Bowman pulls Gallagher from the wreckage, and the two – the only survivors of the Mars 1 mission – set course for earth.

the majority of these cuts, which principally involved greenscreen elements of Carrie-Anne Moss combined with various Mars and starfield backgrounds and a CG tether. Two distant views of Bowman on approach to the Cosmos employed imagery produced at Digital Domain that featured fully CG figures and ships.

With the Cosmos and Gallagher in tow, Bowman reels herself aboard the Mars 1, making an extremely rough landing. "Production got some stunt people wired up for the big finish," Jeff Okun recalled, "and then we got to watch them get slammed really hard into the actual set." Flash Film Works handled wire removals for the sequence and created additional 3D elements to enhance the crash. "When the probe docks," noted Bill Mesa, "it flips over in the bay, shearing off some of its structural elements. We modeled and animated a number of breakaway Cosmos parts to go flying right past camera."

Red Planet concludes as the mission survivors embark on the long journey home, bearing hope that the nematodes Gallagher has collected from the Martian surface can be used to help restore earth's ravaged environment, as the creatures will be able to consume the planet's toxic wastes while producing regenerative oxygen as a byproduct.

The embattled visual effects team was dealt a final blow near the end of its assignment, when the studio made a last-minute decision to lock the picture one week earlier than originally scheduled. Okun was forced to jettison a number of shots that were still in progress at several facilities, and wound up using and reusing abandoned elements in order to finish the assignment within the newly revised time-frame. "It was a long, tough show," Okun concluded, "but I was very happy to involve my longtime friends and collaborators at Flash Film Works, Digital FilmWorks, Grant McCune Design and Hammerhead, and to give Fine Grain Films an opportunity to branch out into doing a few finals. Plus, this show gave me the chance to work with some companies I had long admired, including Pixel Magic and Illusion Arts. And then there was Cinesite, which did remarkable work with AMEE, who in her own way is as much the star of this movie as Val Kilmer. There's been a large measure of satisfaction for me in getting all of this to come together."

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- CHARACTER TECHNICAL DIRECTORS
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- LIGHTING ANIMATORS
- ORACLE DBA/APPLICATIONS DEVELOPER
- PIPELINE TOOL ENGINEER
- SHAKE TECHNICAL DIRECTOR
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